DISSERTATION ON

" CLINICAL STUDY AND MANAGEMENT OF URETERIC CALCULI IN THANJAVUR MEDICAL COLLEGE HOSPITAL "

M.S.DEGREE EXAMINATION
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GENERAL SURGERY

THANJAVUR MEDICAL COLLEGE AND HOSPITAL

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MAY – 2018

CERTIFICATE

This is to certify that dissertation entitled **" CLINICAL STUDY AND MANAGEMENT OF URETERIC CALCULI IN THANJAVUR MEDICAL COLLEGE HOSPITAL "** is a bonafide record of work done by **DR. R. SARAVANAN,** in the Department of General Surgery, Thanjavur Medical College, Thanjavur, during his Post Graduate Course from 2015-2018 under the guidance and supervision of **PROF.DR. M.ELANGOVAN, M.S, F.I.C.S.,** This is submitted in partial fulfillment for the award of **M.S. DEGREE EXAMINATION- BRANCH I (GENERAL SURGERY)** to be held in MAY 2018 under the **Tamilnadu Dr. M.G.R. Medical University, Chennai.**

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DECLARATION

I declare that this dissertation entitled **" CLINICAL STUDY AND MANAGEMENT OF URETERIC CALCULI IN THANJAVUR MEDICAL COLLEGE HOSPITAL "** is a record of Work done by me in the department of General Surgery, Thanjavur medical college, Thanjavur, during my Post Graduate Course from 2015-2018 under the guidance and supervision of my unit chief **PROF. DR. M. ELANGOVAN, M.S, F.I.C.S.,** It is submitted in partial fulfillment for the award of **M.S. DEGREE EXAMINATION- BRANCH I (GENERAL SURGERY)** to be held in MAY 2018 under the **Tamilnadu Dr. M.G.R. Medical University, Chennai.** This record of work has not been submitted Previously by me for the award of any degree or diploma from any other university.

Date : **DR.R.SARAVANAN**

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CONTENTS

INTRODUCTION

INTRODUCTION

"*I remember not my life without the pain of the stone in the kidneys (even to the making of bloody water upon any extraordinary motion) until I was about twenty years of age" .*

One of the best historical vignettes about ureteral calculi by Dr Samuel Pepys , famous for bladder stone management and surgical interventions which describes *renal colic* which is one of the strongest pain sensations ever known. Ambroise Paré is documented to be the first person to report a ureteral calculus, when, in 1564, he described "the cruel pain [that] tormented the patient in that place where the stone lodged[1] . The existence of urinary tract stones dates back to 4800BC and lithotomy procedure for removal of stones is said to be one of the earliest noted surgical procedures[2]. The Roman medical treatise by Aulus Cornelius Celsus named *De Medicina*, contains a description of lithotomy, which served as the basis for this surgical procedure until the 18th century[3]. Later in the 20th century , newer advances in technology have led to a better understanding of structural and chemical characteristics of calculi. In 1980, the introduction of the first extracorporeal shock wave machine, saw a dramatic shift in stone management. Scientific developments in parallel with civilization has enabled us to reach a point where we defer to "cut" patients for calculi, as Hippocrates admonishes, instead manage them with minimally invasive treatment alternatives .This is a study of 100 patients with ureteral calculus disease seen in the period of two years from 2015 to 2017 with particular reference to clinical epidemiology.

AIMS AND OBJECTIVES, RIEVIEW OF LITERATURE

AIMS AND OBJECTIVES :

1.To evaluate all in patients with calculus disease of ureter with special reference to clinical epidemiology including

a.Age and sex incidence,

b.Clinical presentation,

c. Distribution of calculi, in ureter,

d. Laterality,

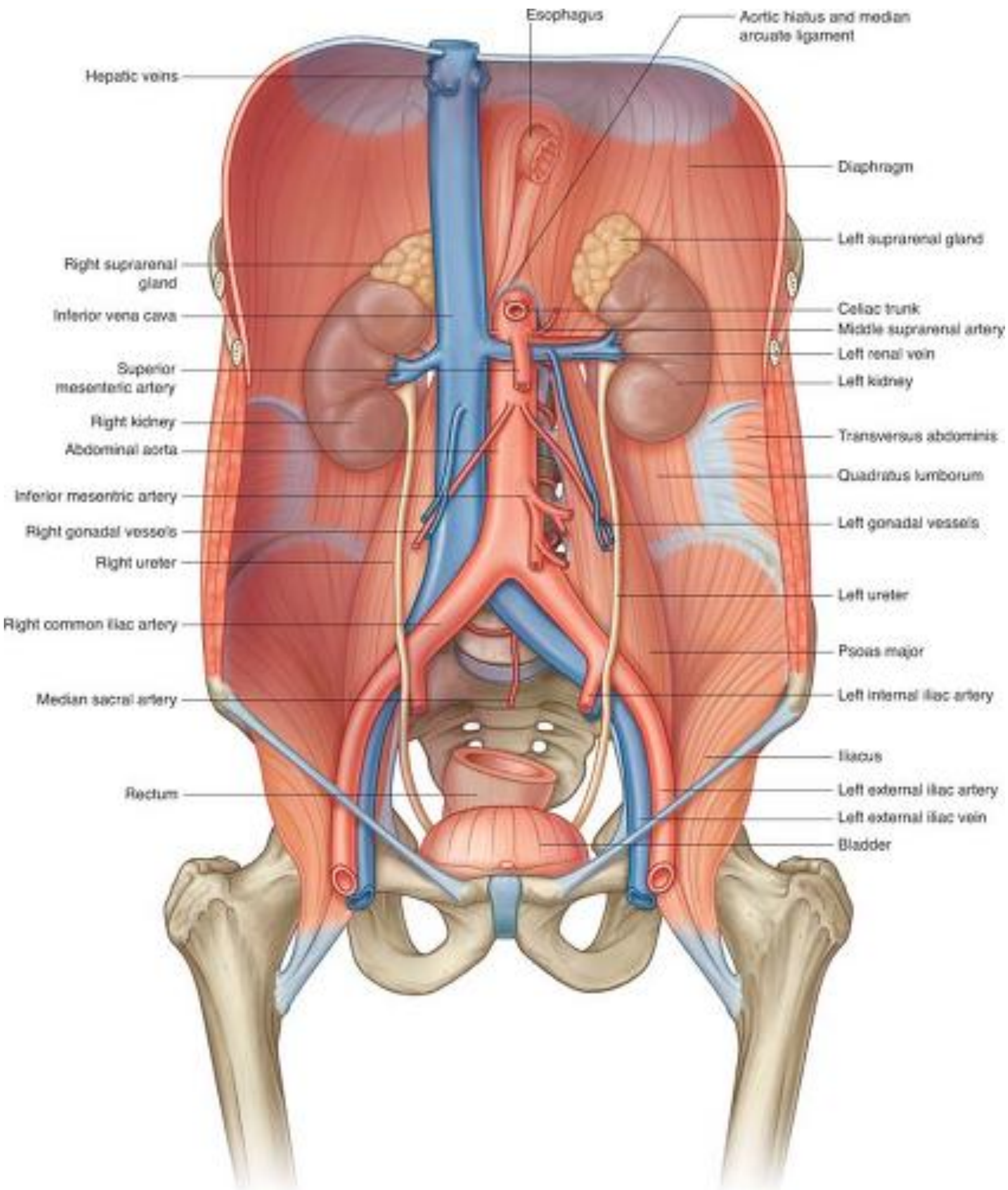
e.Alteration in urine culture.

2.To evaluate treatment selection and outcome.

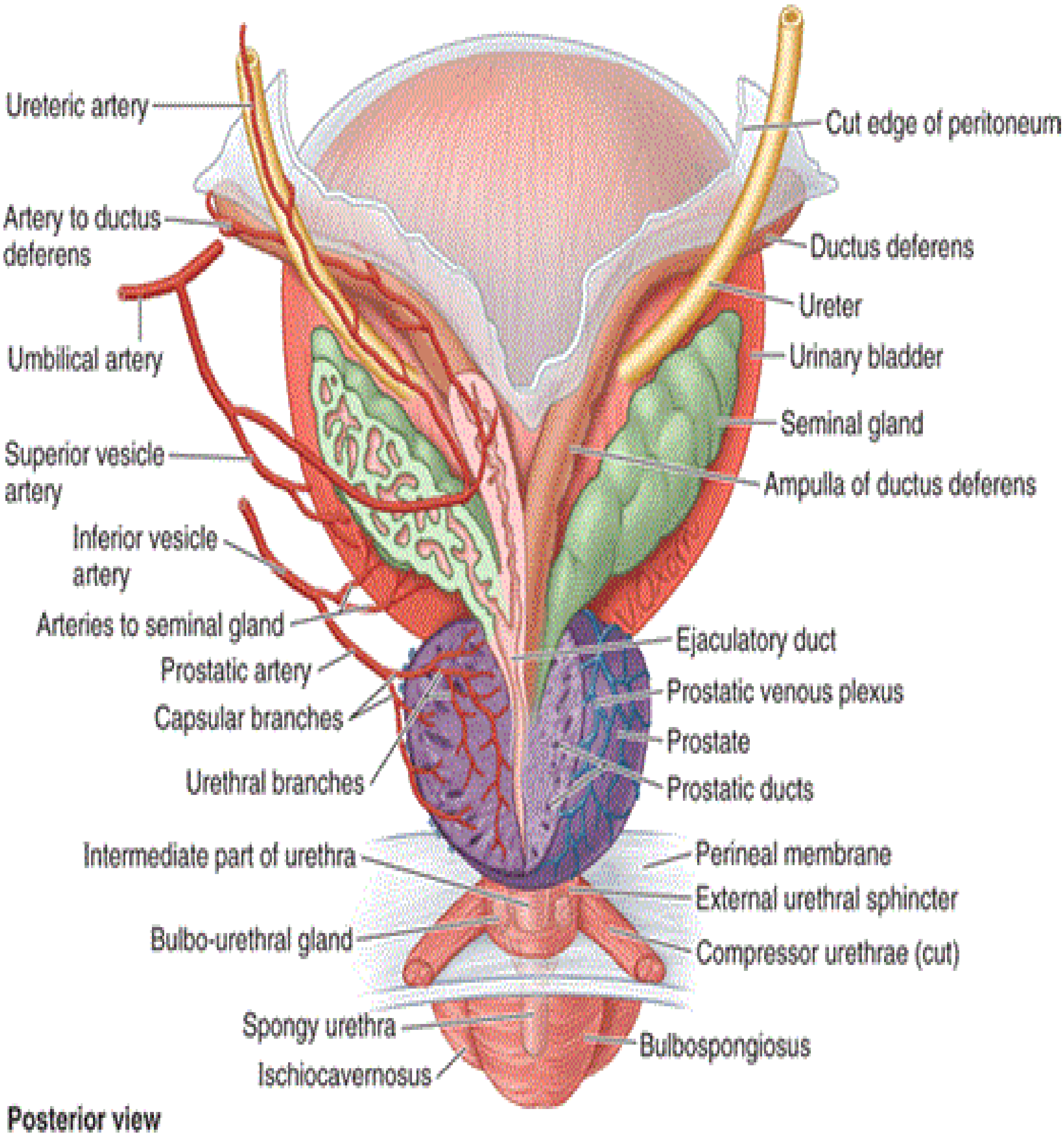
3.To compare the results with similar studies

REVIEW OF LITERATURE

Urinary calculus disease accounts for the third most common condition of the urinary system next only to infections and diseases of the prostate[4]. Ureteric colic Is a frequentmedical and surgical emergency which is most commonly due to an obstruction of the urinary tract by calculi[5]. Recurrence rates are close to 50% in 5-10 years and 75% in 20 years[5].Stonesare solid concretions of minerals which are constituents of urine.



Anatomy of Kidney, Ureter and Bladder



Anatomy and relations of pelvic ureter, bladder, prostate, seminal vesicle and vasa deferentia

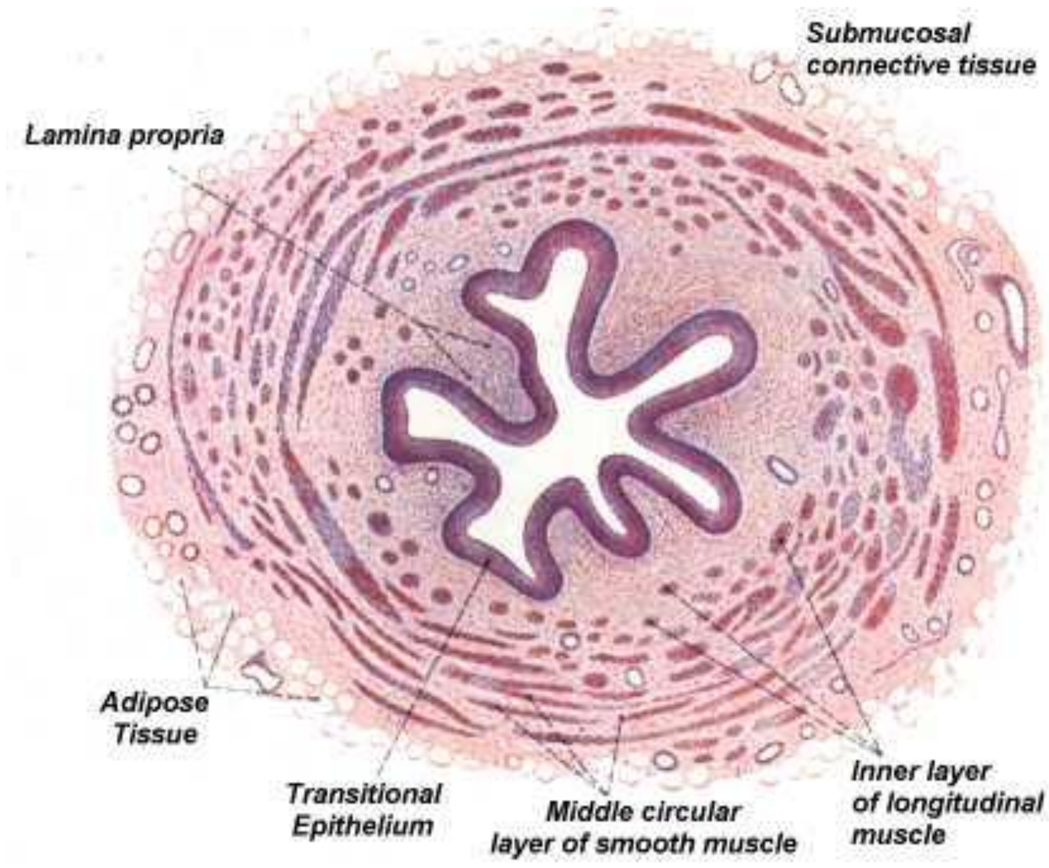
ANATOMY OF THE URETERS

URETER- ANATOMY

Ureters are bilateral completely retroperitoneal tubular structures that transport urine from the renal pelvis to the bladder[1].They are generally 22 to 30 cm in length varying directly with patients height and renal location. The average ureteral diameter is 10mm in the abdominal location and tapers to 5mm in the pelvis. Ureters are composed of a multilayered wall with an inner longitudinal and an outer circular layer of muscle. The muscular layer is continuous with the renal collecting system and urinary bladder.

The inner lining of transitional epithelium prevents absorption of fluid and electrolytes in the usual healthy state. The outermost adventitia has a dense network of collagen and elastic fibers in which course the vessels and nerves. This layer is continuous with the renal pelvic capsule proximally and distally with the true fibrinous tissue known as Waldeyer's sheath.

The ureter begins at the ureteropelvic junction lies posterior to the renal artery and vein. It then progresses inferiorly along the anterior edge of the psoas muscle. Anteriorly, the right ureter is related to the ascending colon, cecum, colonic mesentery, and appendix. The left ureter is closely related to the descending and sigmoid colon and their accompanying mesenteries. Approximately a third of the way to the bladder the ureter is crossed anteriorly by the gonadal vessels from medial to lateral . As it enters the pelvis the ureter crosses anterior to the iliac vessels. This crossover point is usually at the bifurcation of the common iliac into the internal and external iliac arteries, thus making this a useful landmark for pelvic procedures.



Histology of Ureter

The ureter follows a path along the dorsal aspect of the retroperitoneum, crossing over the sacrum at the sacroiliac joint and into the true pelvis. Once in the pelvis, the ureter will course medially to enter the bladder just cephaled to the ischial spine.

Three natural points of narrowing of the ureters exist; the ureteropelvic junction, ureterovesical junction and where the ureter crosses the common iliac vessels in the mid ureter. Radiologically the ureters are described as three segments:

Upper (renal pelvis to upper border of sacrum)

Middle (down to lower border of sacrum)

Lower or pelvic (extends to the bladder).

From a surgical stand point , the ureters are distinguished as the pelviureteric junction, intermediate tract , and the ureterovesical junction.

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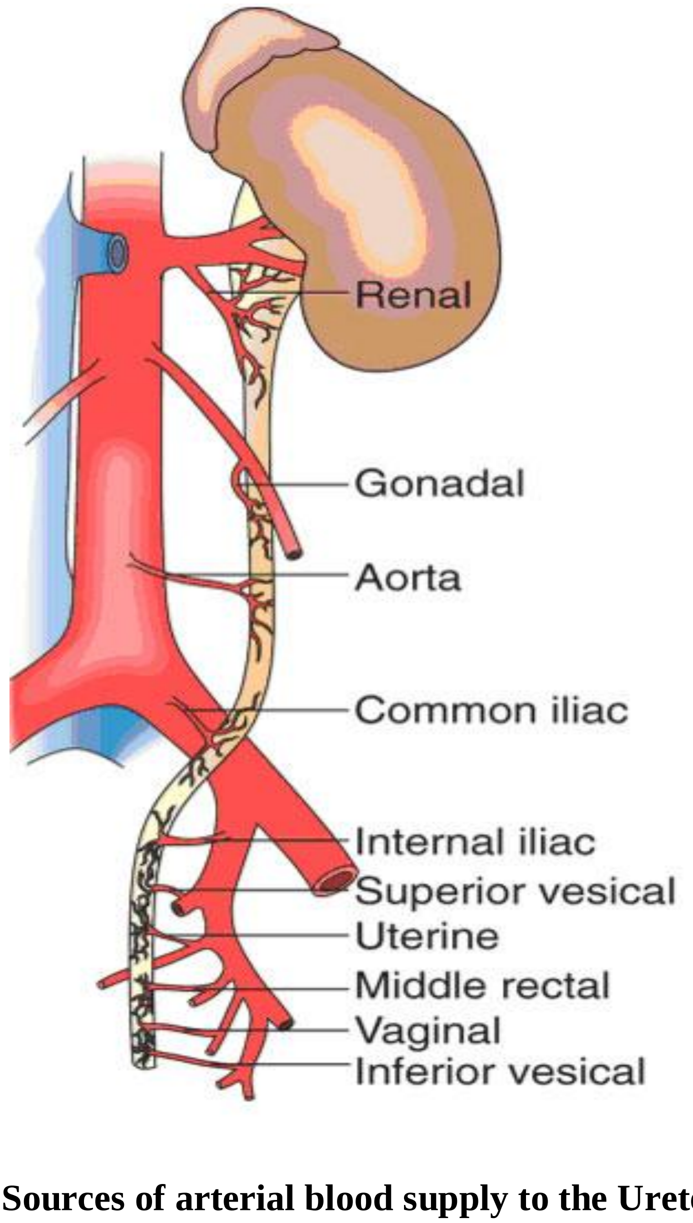
VASCULATURE

The ureter receives its multiple and variable blood supply in a segmental distribution, depending on its level. From proximal to distal , the ureter receives vascular branches from the renal artery, gonadal artery, abdominal aorta and common iliac artery and finally, branches of internal iliac artery. The iliac region of the ureter has the fewest direct arterial branches. The feeding arterial branches approach the ureter medially in the upper ureter and laterally after crossing the iliac vessels in the pelvis.



Sources of arterial blood supply to the Ureter

Surgically , it is important to be aware of the apparent vascular course to the affected ureteral segment. Laparoscopic or endoscopic intervention should be limited to the contralateral area (i.e. lateral in the upper ureter and medial in the lower ureter). On reaching the ureter, the perpendicular arterial vessels turn and course longitudinally within the periureteral adventitia as an extensive plexus. Venous drainage follows the arterial supply[6].

EPIDEMIOLOGY

Urolithiasis is a complex disease and an understanding of the epidemiology, specifically the interactions among various factors, may help to formulate approaches that may significantly reduce the risk of calculus formation[7].The epidemiology of urinary calculus disease differs according to the geographical area in terms of incidence and prevalence, age and sex distribution,stone location and composition[8]. Kidney stones are common in the industrialized countries with the annual incidence ranging from 0.5% to 1.9%[9]. Anderson in 1973[10], submitted a multifaceted theory of epidemiology of urinary calculi. He observed that the incidence of upper urinary tract stones varied with age, geographic distribution and anatomic site, but unexplained increases in the course of time have occurred. He , therefore believed, that there are intrinsic and extrinsic epidemiologic factors involved in the formation of urinary calculi. The intrinsic factors are those related to the inherited anatomic or biochemical profile of the individual. Intrinsic factors include race, ethnicity and familial background along with any inherited anatomic or physiologic predisposition to urinary stone formation. Extrinsic factors are the environmental factors that include drinking water, climate, dietary patterns of individuals, occupation and most importantly presence of trace elements in drinking water and food .Earlier epidemiological studies have shown that the prevalence rate ranged between 4% and 20% in economically developed countries[11] . Many of the previous studies emphasize the impact of lifestyle and dietary practices along with access to better medical care for the formation of urinary stones[12]. There seems to be an age and gender dependant formation of urinary stones and their composition[13].

INCIDENCE AND PREVALENCE

The incidence of urinary tract calculus disease has dramatically increased over a twenty year period and the lifetime risk is now calculated to be 10-15%[7] .Previous reports have shown the prevalence of kidney stones to vary greatly between different geographic locations, ranging from 8% to 19% in males and from 3% to 5% in females in Western countries[8]. A study from Germany has shown prevalence to have risen from 4% to 4.7% from the year 1979 to 2001[14.] Previous epidemiological studies of stone disease have demonstrated various stone belts or regions in the many developed and developing countries worldwide. In Asia,the stone belt comprises six countries - India, Iran, Iraq, Saudi Arabia, Singapore and Malaysia. In India ,upper and lower urinary tract stones occur frequently but the incidence shows wide regional variation[15] .The stone belts in India are Northern and Central India as demonstated by Colobawala in 1971[16] . In the Indian scenario, the prevalence of urinary stones is 15 per cent. The occurrence of stone disease is high in the North western Nnorthern and Central parts of India. The incidence is moderate in the Deccan Plateau and less in Southern India[17]. In India there are two stone belts. North India forms the ‘First Stone’ belt. Parts of Gujarat Maharashtra and Jabalpur in M.P form the ‘Second Stone’ belt. Eighty per cent of kidney stones are passed naturally without damage to kidney while 20 per cent prove harmful. In the study, by Pendse and Singh[18], the incidence of renal calculi was observed to be comparatively lower in the southern part of India compared to other parts.

AGE

Most of the urinary stones are formed in adults[12]. Several investigators have pointed out that the peak incidence of urolithiasis is in between 20 and 50 years[19,20]. Age distribution of calculus disease among various populations is reported as the age of initial incidence or initial prevalence within a particular age group. The majority of patients report onset of symptoms of the disease in the 2nd decade of life with decreasing onset through the 3rd , 4th and 5th decade[20]. Earlier studies conducted in countries like Japan,USA and Iran have shown that age at peak incidence of stone formation was almost similar among the three countries, ranging from 40 to 49 years, except in Japan where women had a peak incidence between 50 to 59 years. The actual incidence rate among men was similar for age ranging from 40 to 49 years in Japan and the United States but was found to be lower in Iran[21]. Previous studies from Italy, Greece ,Germany, Iceland, Turkey ,Iran , and the United States , have shown that stone prevalence increased with increasing age[22]. In Korea,the prevalence rates decreased in men with age, but increased in women with a peak at age 60 to 69 years[22.]

Urolithiasis remains a rare disease in children with the overall incidence being stable in most studies[23]. As in adults, factors such as obesity that are linked to the metabolic syndrome complex pose risks for urinary calculus formation in children [24,25]. Moreover, malnutrition in infancy due to early weaning particularly with cereal diet has increased the incidence of endemic infantile bladder stone disease in developing countries with stones composed of calcium oxalate and ammonium urate[8]. Carbohydrate intolerance together with chronic diarrhoea and intraluminal breakdown of sugars by enteric bacteria might be an aetiological factor resulting in chronic metabolic acidosis leading to stone formation [26].

MALE FEMALE RATIO

Urolithiasis is a disease with a clear male predominance for all stone types except for those due to infection. Michaels et al[27] in 1994 had observed that calcium oxalate stones were more frequent in the fifth and sixth decades of life and in a M:F ratio of approximately 2:1 . Scales et al[28] , observed a change in the prevalence of treated stone disease by gender from a 1.7:1 to 1.3:1 male-to-female ratio between 1997 to 2002. The increasing incidence of urinary calculi in women might be due to lifestyle changes like obesity[12].In the study by Knoll et al[29], a 2.7:1 male-to-female ratio was observed for the most common calcium-containing calculi. Daudon et al[13] observed a male predominance for calcium oxalate and urate stones and a female predominance for struvite and calcium phosphate stones. In developing countries the male-to-female ratio range from 1.6:1 in Thailand and 1.15:1 in Iran [30,31] to 5:1 in Saudi Arabia 2.5:1 in Iraq[32,33].

The study by Parks and Coe[34], showed that the urine of men is close to the calcium oxalate solubility product and this may explain the male predominance for calcium oxalate stones. In 1972, Liao and Richardson[35], reported that elevated serum testosterone levels led to an increase in oxalate production endogenously by the liver .

Schorr et al[36] in 1942, demonstrated the effect of sex hormones on urinary citrate levels. They showed that progesterone and estrogen support high levels of citrate in urine during the secretary phase of menstrual cycle in normal females. Estrogen if administered to non-ovulating women increased the urinary citrate and testosterone administration to men with hypogonadism was shown to decrease citrate levels in urine . Welshman and McGeown[37] in 1976, studied the differences in urinary citrate levels among normal controls and stone formers and observed that postmenopausal women did not seem to have the protective higher levels of urinary citrate as seen in younger women . Finlayson[38] in 1974, postulated that lower testosterone levels in women and children may be a protective factor against oxalate stone disease.

PRESENTATION

A urinary calculus announces its presence usually with an acute episode of renal or ureteric colic. Ureteric colic is an acute, colicky pain in the flanks radiating to the groin. The pain is usually described as the worstever pain the patient has experienced. Uroliths are symptomatic only when they get trapped in certain segments of the upper urinary tract particularly the narrowest anatomical areas of the ureter such as the pelviureteric junction, near the pelvic brim at the crossing of the iliac vessels and the vesicoureteric junction (VUJ). Beyond the ureteropelvic junction,at the point where the ureter crosses over the iliac vessels , the diameter narrows to about 4mm.Stones at this level obstruct urine flow.Stones in the upper ureter will frequently experience sharp ,spasmodic pain of acute onset,localized to the flank.As the stone passes down to the level of the pelvic brim,the pain is sharp and intermittent, corresponding to the peristalsis of the ureter.The pain will radiate to the lateral flank and abdominal area and may be accompanied by nausea and vomiting.The pain is intermittent ,with intense pain followed by periods of relief. The site of pain may be related but often is not an accurate predictor of the location of the stone within the urinary tract. As the stone approaches the narrow vesicoureteric junction, bladder irritability symptoms begin to appear[5]. Another area of entrapment of calculi particularly in females ,is the posterior pelvis , where the ureter is crossed anteriorly by the pelvic vessels and the broad ligaments. There may be a tenderness at the costovertebral angle or lower quadrant. Gross or microscopic haematuria is usually present in approximately 90% of the patient, however, haematuria may be absent in some patients[5].

Many earlier studies have tried to demonstrate the possibility of spontaneous passage of ureteral calculi in relation to their size. Stones less than 5 mm in diameter have a greater chance of passage compared to those of 5–7 mm which have a modest chance (50%) of passage, and those greater than 7 mm , frequently require urologic intervention[39]. Moderate pyuria may occur even in patients with uninfected urinary lithiasis. When significant numbers of pus cells are present in the urine, however , a thorough search for infection should be made.

URETERIC CALCULI

LATERALITY

Ureteral calculi are found to be equally frequent on both the left and right ureters, although in certain patients stone formation seems to be limited to one side. Many observers,have shown that ureteric calculi were found in equal frequency on the two sides with no side predominance for the ureteral stones[40,41,42]. But, Kretschmer[43] in 1942 in his review of 500 cases found that 45.8% calculi were right sided and 51.8% were left sided. Drach et al in 1986[20] and Segura et al [44] 1985, observed a slight left sided preponderance of stones .

SIZE

Size of the stone is of considerable importance but of equal importance is the size of the ureter below the stone[45]. Stone size is generally mentioned in one or two dimensions and the greatest linear dimension of a stone as visible on CT or plain radiograph is used to determine stone size . Stones are stratified as those measuring up to 5mm, 5-10 mm, 10-20 mm, and > 20 mm in largest diameter[46]. The study by Prstojevic et al[47] showed that the most common size of the calculi observed was 15 mm. However the mean stone size was 5.7 mm, in the study by Ahmed et al[48]. Song and colleagues[51] observed the mean size of the stones to be 4.87±3.49 mm .The general rule is, larger the calculus ,less likely is it to spontaneously pass, and the manipulative efforts will more frequently fail to succeed[45]. Most of the small stones and many of the larger stones pass spontaneously . 95% of ureteral stones 2 to 4 mm in size will pass spontaneously[49]. Only 50% for stones greater than 5 mm and stones greater than 6 mm have a still lower rate of spontaneous passage[50,51]. Duration for stone passage may be as long as 40 days[50.] Coll et al[52] ,in 2002 have observed the spontaneous expulsion rate for stones 1 mm in diameter was 87% , 2-4 mm in diameter was 76% , 5-7 mm was 60%, for stones 7-9 mm was 48%; and for stones larger than 9 mm was 25%. The authors of the 2007 AUA Ureteral Stone Guidelines reported that a meta-analysis study comprising five patient groups (224 patients) showed that 68% of patients with <5mm stone passed spontaneously. For stones >5 mm and ≤10 mm, analysis of three groups (104 patients) observed that

47% passed spontaneously[53,54] . Stone size is the simplest and most common method of assessing stone burden[55]. Accurately measuring stone size is of paramount importance as it helps to determine the appropriate intervention whether a patient is a candidate for medical therapy or urologic intervention[54].

LOCATION

The ureter is described as having three anatomic sites of narrowing at which kidney stones typically become lodged: The pelviureteric junction (PUJ), the ureteral crossing of the iliac vessels, and the ureterovesical junction (UVJ). Location in the ureter appears to be an important determinant of stone removal efficacy with ureteroscopy (URS), whereas it doesnot appear to impact the results of Extra-corporeal shock wave lithotripsy (ESWL) substantially [53.] . Coll and colleagues[52] , have observed a spontaneous passage rate based on stone location which was 48% for those in the proximal ureter, 60% for mid ureteral stones, 75% for distal ureteral stones, and 79% for stones in the ureterovesical junction.One of the earlier studies observed a significant predominance of lower ureteral stones with 63% in distal ureter and 87% at the VUJ[40] . In the study by Song and collegues[51] ,in (46.3%), stones were located at ureterovesical junction (UVJ) , (30.5%) in proximal ureter and in 16.8% in distal ureter.A study from Nepal ,also observed distal ureter to be the most common site of ureteric stone[56] .In the study by Ordon and collegues, stones ≥100 mm were distributed more proximally[57] .

STONE COMPOSITION

Renal stones are broadly categorised into calcium containing stones, which are radio-opaque, and non-calcareous stones. Most renal calculi are radiopaque, except xanthine stones and uric acid stones which may be radiolucent. A low fluid intake leading to small daily urine volumes contributes to increased concentration of solutes in the urine and thus increases the risk of stone formation. Several drugs, such as carbonic anhydrase inhibitors , uricosuric agents , vitamins C and D, absorbable antacids and drugs that crystallize in urine (e.g., acyclovir, sulphonamides, triamterene), can lead to stone formation. Frequent urinary tract infection with urea-splitting organisms, such as Proteus, may cause struvite stone formation[58]. Understanding the chemical composition of urinary stones is critical for understanding the pathophysiology , determining the optimal treatment modality and for prevention of recurrences[59]. The presence of crystals and urease-positive bacteria in urine ,urine pH , plain radiographs, and a previous history of urolithiasis have long been used to predict the stone composition [60.] Mostafavi et al [61],in 1998 performed an *in vitro* study and obseved that stone composition could be predicted with high accuracy using HounsfieldUnits(HU). Motley et al[62], attempted to determine the composition of urinary system stones using HU density, which was calculated by dividing HU by the greatest transverse diameter of the stone (in mm), and suggested that HU density was more effective than HU alone. However, the authors also suggested that neither HU density nor value was sufficient for determining the *in vivo* stone composition [62]. In a study by Kawahara et al [63], the mean Hounsfield units (HUs) of the CT density were 1046 HUs in calcium oxalate, 1101 HUs in mixed calcium phosphate and calcium oxalate, 835 HUs in calcium phosphate, , 729 HUs in struvite, and 698 HUs in cystine,549 HUs in uric acid. Uric acid stones in vitro have CT density below 1000 HU, and calcium phosphate typically have densities greater than 1000 HU .Beyond this gross range, the overlap of values precludes any more exact determination of stone composition by CT density. Most ureteral stones are generally resistant to medical dissolution therapy. However, in moderately symptomatic or asymptomatic patients with an incomplete obstruction due to a uric acid stone, urine pH manipulation may be attempted as part of a conservative treatment approach. In the majority of patients , with calcium based ureteral stones the exact composition is rarely known. Moreover ,the responsiveness to SWL varies even among patients with chemically similar stones . Urine pH manipulation should also be considered for the patient who does not desire or cannot medically tolerate anaesthesia for ESWL or ureteroscopy and who is thought to harbor a uric acid stone.

In a study from Malta, majority of stones (83.3%) contained calcium, in combination with negatively charged molecules such as oxalate (77.6%), phosphate (14.7%), and carbonate (2.8%). Stones like urate (11.6%), cysteine (4.6%), and ammonium-magnesium-phosphate (0.5%) constituted only a minority of stones. Calcium phosphate stones were more common in females[60]. Stone composition is undoubtedly important in determining efficacy of stone treatment , especially ESWL . Stone composition provides useful information in selecting the mode of intervention as dramatic differences have been observed with radiolucent uric acid calculi which are easily fragmented with ESWL and the relatively radiolucent cysteine calculi which are often refractory to ESWL[64] .

STONE ANALYSIS TECHNIQUES

There are various techniques available for determining the urinary stone structure and composition. However, no single method provides all the necessary information. Therefore, a combination of morphological and structural tests is essential for the purpose[59].

CHEMICAL

Chemical techniques detect limited number of individual ions which only gives arbitrary information about the composition. In this technique,the stone is dissolved in a strong acid after which various chemicals are added, which then leads to the formation of gas or coloured products depending on the ions present. However,crystal structures cannot be identified and these techniques have high error rates.[65]

OPTICAL

Binocular dissection microscopy with petrographic (polarization) microscopy, Scanning electron microscopy and Transmission electron microscopy Used for the study of crystalline forms and organic matrix

PHYSICAL

Infrared spectroscopy ,X-ray diffraction,Radiographic crystallography and Thermoanalysis

INFRARED SPECTROSCOPY

Photons possessing energy that exactly matches with the vibration energy of a covalent bond are absorbed. An infrared spectrum shows which bonds have absorbed radiation (wavelength) and this combination of intensities and wavelengths generates a unique fingerprint for each compound, which can be used for accurate quantitative and qualitative analysis of kidney stones[65].

Infrared spectroscopy, polarisation microscopy and X-ray diffraction are the internationally recommended techniques for kidney stone analysis . Mixed stones are generally more common, and infrared spectroscopy which is the gold standard can be used with high accuracy to determine the relative percentage of the various components[59,65] .

BACTERIOLOGY

There are three mechanisms by which bacteria may contribute to stone formation. One possible mechanism is that bacteria adhere to crystals leading to inceased crystal – cystal agglomeration. Next mechanism is the production of citrate lyase by bacteria, which could decrease the urine citrate levels thereby leading to supersaturated urine and crystal formation[66]. The study by Golechha and Solanki[67],has shown that E.coli was the commonest pathogen recovered from patients with mixed stones composed of calcium oxalate with calcium phosphate and triple phosphate from pre-operative urine and stone culture (32.25% and 21.73%) which was followed by Pseudomonas (22.58% and 17.39%) . However, Holmgren[68] had observed Proteus to be the most common organism occurring in 7% of the cases. In a 1972 study, carried out on 725 patients with calcium phosphate stones, 70% were infected, in most cases with *Escherichia coli* or *Proteus* spp[69].

PATIENT RISK FACTORS

Robertson[70] in 2003,stressed that there was an increasing incidence of urinay stone disease in the tropics where the risk of calculus formation is complicated by low urine volume. Hot climates expose people to more ultraviolet light,thereby increasing vitamin D3 production. Increased oxalate and calcium excretion has been associated with increased sun exposure. Global warming may increase the incidence of urinary calculus disease[71].

Patients of all racial groups with urinary calculi demonstrated a similarity in the incidence of underlying metabolic abnormalities which suggests that dietary and environmental factors may be as important as ethnicity in the etiology of urolithiasis [72].

It is well known that greater intakes of dietary potassium, calcium and total fluid reduce the risk of urolithiasis, while supplemental sodium, calcium, animal protein, and sucrose may increase the risk. Phytate intake and fluid were found to reduce the risk of stone formation whereas animal protein and sucrose increase the risk of particularly in young females. On the other hand in older adults the relation between urinary stones and diet may be different as the metabolism of many of the dietary factors may change with age[8].

Type 2 diabetes, obesity, and hypertension are well accepted risk factors in the development of urinary stones and in particular diabetes may be a risk factor in the formation of uric acid stones [73]. Insulin resistance, related to type 2 diabetes and the metabolic syndrome, impair the renal ammoniagenesis thereby lowering the urine pH and promoting uric acid stone formation [74].

The obesity epidemic may be an important cause for the increasing numbers of patients with urolithiasis. Patients with high waist-to-hip ratios or central adiposity appear to have the highest risk [75].In the study by Kramer et al[76] ,no association was found between menopause and postmenopausal hormonal intake and incident urolithiasis.

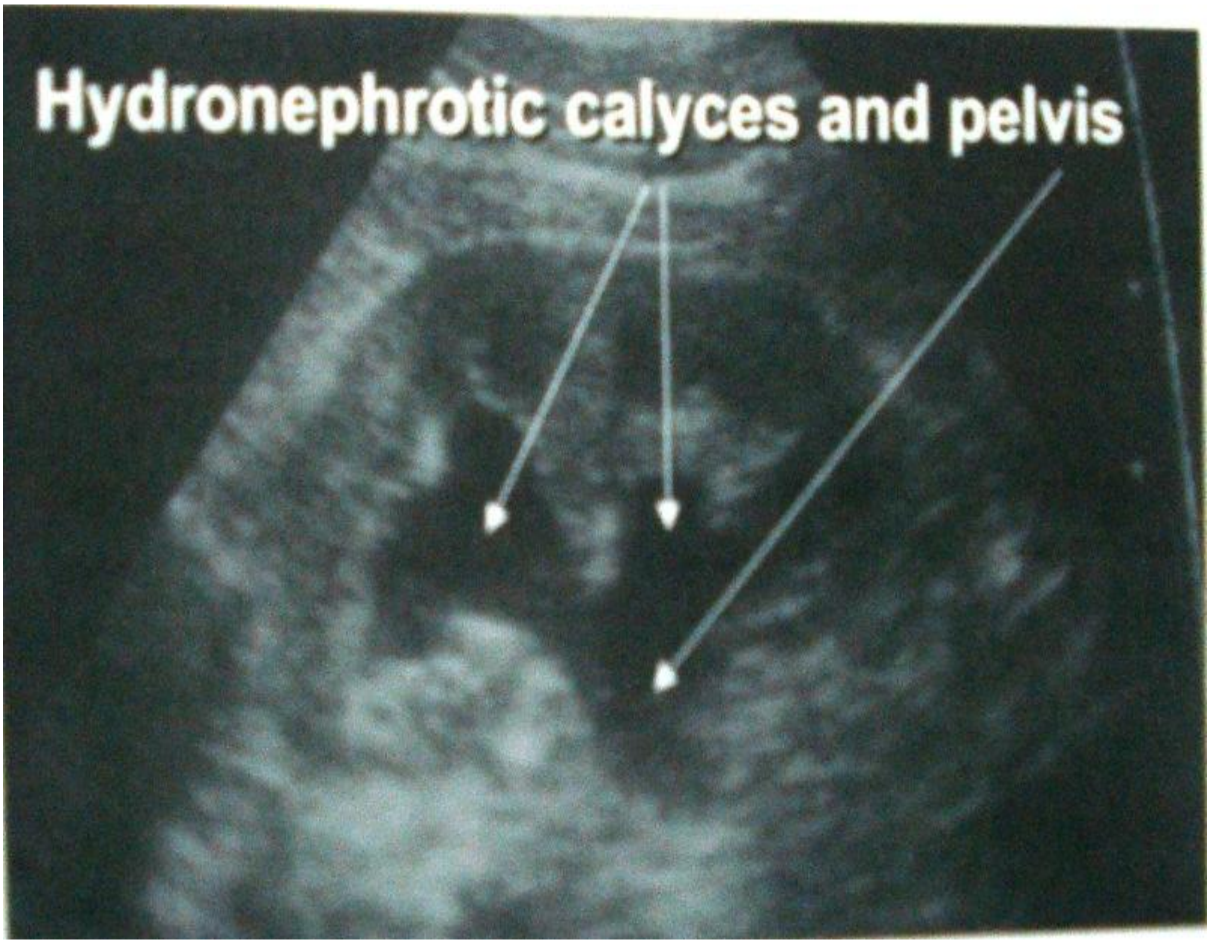
DIAGNOSTIC MODALITIES

Besides routine history and clinical examination in patients with suspected ureteric colic , the principal investigations include ultrasound ,plain abdominal radiography, computed tomography and intravenous urography[5].

Urinalysis should be performed in patients with suspected calculi. Salient findings to be noted are microhematuria, pyuria, urine pH and the presence of crystals, which may help identify the stone composition. A urine pH greater than 7 suggests the presence of urea-splitting *Proteus, Klebsiella ,Pseudomonas* species, and struvite stones. A urine pH less than 5 suggests uric acid stones. Crystalline material can be seen in the urine. Morphology of the crystal may indicate the chemical composition of the stones for example hexagonal crystals are seen in patients with cystine stones. The initial workup must include serum calcium, uric acid ,creatinine, potassium ,phosphorus and bicarbonate measurements. If three normal serum calcium values are obtained hyperparathyroidism is unlikely [58].

PLAIN RADIOGRAPH OF THE KIDNEY, URETER AND BLADDER(KUB)

KUB has a sensitivity that ranges from 45–60% in the evaluation of acute flank pain[77]. Overlying stool or bowel gas can preclude the identification of ureteric stones by KUB. Visualizing radiolucent stones which make up for 10–20% of the stones is not possible with KUB[5].



USG abdomen showing hydronephrotic calyces and pelvis

ULTRASONOGRAPHY(USG)

USG allows for direct visualisation of urinary stones that are situated at the PUJ, the VUJ, and in the renal calyces or pelvis[78]. Stones located between the PUJ and VUJ, however, are extremely difficult to visualise with ultrasonography.

INTRAVENOUS UROGRAPHY (IVU)

Since 1923 ,Intravenous urography (IVU) has been the ‘‘gold standard’’ in the evaluation in ureteric colic. IVU has a detection rate of 70– 90% and it provides structural and functional information, including the site, nature and degree of obstruction[79]. However , it can only visualise stones that are radiopaque which account for 80–90% of the stones. Despite the usefulness of IVU, there are certain disadvantages which include risk of nephrotoxicity , radiation exposure, contrast reaction and the time duration, when delayed films are required [5].

NON-CONTRAST ENHANCED COMPUTED TOMOGRAPHY (CT)

Unenhanced spiral CT has largely replaced IVU and has become the first line investigation with sensitivity, specificity and positive predictive value of 96%, 100% and 100%, respectively[80].

CT can visualise radiopaque, as well as radiolucent stones. CT confirms the presence of a stone, and a plain KUB is necessary to assess the radiopacity of the stone. This is indeed helpful as only the KUB is needed to determine the dislocation of the stone later[5] . Other benefits of CT are avoidance of intravenous contrast medium and identification of extra-urinary pathology in patients in whom a definitive diagnosis is not apparent. The incidence of extra-urinary abnormality detected with CT is reported to be 6–12%[81].

CT abdomen showing stone at distal ureter

DISADVANTAGES OF CT

One of the most important limitations of CT is that it does not permit functional evaluation of the kidneys and is unable to assess the degree of obstruction,evident during IVU,which might compromise clinical management. However, some authors have suggested that secondary features of obstruction that can be picked up on CT include hydronephrosis, renal enlargement, hydroureter and inflammatory changes of the perirenal fat, referred to as perinephric stranding. These can be a reliable parallel of delayed excretion on IVU[82].

Another disadvantage of CT is that patients are exposed to at least three times the radiation exposure of IVU and 10 times that of abdominal radiography and presents an additional lifetime risk of malignancy of 1 in 4000[83]. Nowadays , low-dose and ultra low-dose CT can reduce radiation exposure by 50% and 95%, respectively, with comparable detection rates of calculi[84] .Cost and availability will always be salient factors in determining the utility of CT in emergency settings[5].

MANAGEMENT OF URETERIC CALCULI

Most ureteric stones pass spontaneously, so most patients are managed conservatively in the form of observation with analgesia. Radiological or surgical intervention is required only when the conservative treatment fails. The probability of spontaneous passage is based on a number of factors including stone size, stone position, degree of impaction and degree of obstruction[5]. The likelihood of spontaneous passage decreases with increase in stone size. It is recommended by many authors that stone passage should not exceed 4–6 weeks due to the risk of renal damage[50].

"Initial management is based on three key concepts:(1) the recognition of urgent and emergency requirements for urologic consultation, (2) the provision of effective pain control using a combination of narcotics and nonsteroidal anti-inflammatory drugs in appropriate patients and (3) an understanding of the impact of stone location and size on natural history and definitive urologic management"[85].

FACTORS AFFECTING MANAGEMENT

STONE FACTORS

Location,size,composition and degree of obstruction.

CLINICAL FACTORS

Symptom severity , patient's expectations , associated infection, solitary kidney and abnormal ureteral anatomy.

TECHNICAL FACTORS

Available equipment and cost

CONSERVATIVE MANAGEMENT

Spontaneous stone passage is allowed provided the passage is likely in a reasonable time frame, with acceptable patient symptoms and a low risk of complications. Conservative management is not appropriate in patients with infections, intolerable patient symptoms, or if managing conservatively would pose a potential threat to renal function[49]. 95% of ureteral stones 2 to 4 mm in size will pass spontaneously **within a period of 40 days[49,50]. Stones above 6 mm in diameter are less likely to pass spontaneously and patients should be counselled about treatment options[86].**

MEDICAL EXPULSIVE THERAPY(MET)

In 1994, Borghi et al[87] , published the initial report of Nifedipine combined with corticosteroids to facilitate stone passage. The 2007 AUA/EAU guidelines for ureteral stone performed a meta-analysis of medical expulsive therapy trials using alpha blockers. It was observed that calcium channel blockers did not produce a statistically significant improvement in stone passage whereas patients on alpha-blocker therapy passed significantly more stones than did patients receiving a placebo[53] . Medical expulsive therapy using alpha-blockers , shortens the duration and increases the likelihood of spontaneous passage of stones. This therapy can be offered to patients with distal ureteral stones less than 10mm in size[49] . Conversely, a recent randomized controlled trial failed to demonstrate any benefit from the use of tamsulosin or nifedipine to promote stone passage[88]. Steroids do provide a slight added benefit , but do not appear to be as important as the alpha or calcium channel blocker.

“The 2016 American Urological Association (AUA)/Endourological Society guidelines have suggested more specific indications for surgical management. The guidelines recommend surgery in the following scenarios [89] :

- Ureteral stones >10 mm
- Uncomplicated distal ureteral stones ≤10 mm that have not passed after 4-6 weeks of observation, with or without MET
- Symptomatic renal stones in patients without any other etiology for pain
- Pediatric patients with ureteral stones that are unlikely to pass or in whom MET has failed
- Pregnant patients with ureteral or renal stones in whom failed observation has failed”

General contraindications to definitive stone manipulation include

- Active, untreated UTI
- Uncorrected bleeding diathesis
- Pregnancy (a relative, but not absolute, contraindication)

Following are the techniques available when the stone fails to pass spontaneously [90]

- Stent placement
- Ureteroscopy (URS)
- Extracorporeal shockwave lithotripsy (ESWL)
- Ureterolithotomy

URETEROSCOPY (URS)

Since the advent of the first URS in 1912, the past century has seen enormous development of the ureteroscope alongwith diversification of its use[91]. Further technical progress led to the introduction of the first rigid ureteroscope in 1980. This was developed by Perez-Castro in collaboration with Karl Storz, incorporating a separate working and optic channel. These developments allowed the art of ureteroscopy to flourish and develop over the last 35 years[92]. Technological advancements in the size and design of the ureteroscopes has enabled easier and better access to nearly all areas in the urinary tract *via* the urethra, thereby removing the need for any surgical incision. High quality digital optics provide accurate assessment of stones and mucosal lesions. Electrohydraulic and ultrasonic lithotripsy were developed later, enabling the fragmentation of ureteric stones .

Modern digital flexible ureteroscopes consists of a fiberoptic lens, with a single cable transferring electronically the image detected at the tip of a scope to the image displayed on a monitor ("Chip to tip" technology)[93]. Stones are commonly fragmented using a holmium laser. The lithotripter, another useful adjuvant for ureteroscopy, has certain limitations like stone retropulsion.

Larger stones, paediatric ,obese patients,pregnancy and patients with bleeding diathesis are becoming more suitable than ever for minimally invasive URS[93]. Stone characteristics that require management with URS include failed previous SWL, radiolucent stones,HU> 1000,size 5 to 30 mm,combined approach with percutaneous nephrolithotomy (PCNL),composition - cysteine, calcium oxalate monohydrate.

The only contraindication is a ureteric stricture preventing successful ureteric access and scope passage[94].

More distal stones have higher success rates with rigid ureteroscopy, compared to the more proximal ones. Proximal stones can sometimes, fall back into the kidney, therefore there is often a requirement of a concurrent flexible ureteroscopy to achieve good stone free rates. Current guidelines recommend URS, over other treatments modalities including SWL, for majority of the ureteric stones[94]

COMPLICATIONS

The overall complication rate for URS is very low and is approximately 3.5% many of which are mostly minor[93]. The most feared of the complications of ureteroscopy is ureteral avulsion, however it is very rare (< 1%). Most common complications are mucosal or ureteric injury (1.5%-1.7%), post-operative fever (1.8%), haematuria, ,urosepsis persistent vesicoureteric reflux (0.1%) and ureteral stricture (0.1%)[95].

FUTURE ADVANCES IN URETEOSCOPY

With decreasing scope size, better optics and newer innovations, no corner of the urinary tract is inaccessible with URS. Robotic surgery has entered the field of urology, recently, particularly in the areas of prostate, bladder and renal cancer treatment. The introduction of robotic flexible ureteroscopy,marked the entry of robotic treatment in ureteral calculus management. Here the “Robot” helps the surgeon to control the flexible ureteroscope and laser fibre via the robotic console. The main robotic station , holds the flexible ureteroscope while the surgeon controls the URS via joystick devices and a console[96].

Another area of future advance, is the use of peptide-coated iron oxide-based microparticles. The microparticles selectively adhere to calcium stone fragments thereby enabling quicker retrieval of stone fragments with the help of a magnetic device[97]

EXTRA-CORPOREAL SHOCK WAVE LITHOTIPSY(ESWL)

Traditionally ureteric stones were managed by open surgical techniques, and it was not until the 1980s with the advent of the Dormier H3 lithotriptor that shock wave lithotripsy (SWL) became common practice[98]. SWL offers a relatively minimally invasive management option for patients, with relatively acceptable outcomes of stone free rates (SFR)[99]. Despite all the advances in ureteroscopes, endoscopic instrumentation and holmium laser, SWL which is the only noninvasive method for stone removal still remains a first-line treatment modality for ureteral calculi.

The lithotriptor breaks up the stone with minimal collateral damage using a focused, externally applied, high-intensity acoustic pulse. A fluoroscopic X-ray or ultrasound imaging system is used to locate and aim at the stone. The acoustic pulse is generated at the ellipsoidal focal point that is farthest from the patient and the stone positioned at the opposite focal point receives the shock wave.SWL is highly efficacious in fragmenting and clearing renal stones up to 2.5 cm in size[100]. This number of shock waves varies based on the recommendations from the specific SWL manufacturers, but generally ranges from 2000 to 4000 shocks for ureteric stones[49]

LIMITATIONS OF ESWL

Some stone types like brushite, calcium oxalate monohydrate, and cysteine stones could be resistant to SWL[101]. Among the stones that were readily broken, fragmentation is not always complete, and the residual fragments often necessitated re-treatment. Certain aspects of renal anatomy like acute infundibulopelvic angle, lower pole calyx and calyceal diverticula could be a barrier to the clearance of stone fragments[102]. Also, the limited capacity of the ureters to discharge stone debri, restricted SWL treatment to a stone size of less than about 2.5 cm[102].

ADVERSE EFFECTS OF ESWL

Shock waves can rupture blood vessels and the resultant bleeding could be severe to the extent of occurrence of intraparenchymal hemorrhage and renal hematomas requiring transfusion, or even nephrectomy. Extrarenal damage such as splenic rupture,intra-abdominal bleeding, and liver and pancreatic hematomas are also reported[103].

URS Vs ESWL

For proximal ureteral stones measuring <10 mm, SWL has a higher stone-free rate than URS ie., 90% and 80% respectively.But for stones >10 mm, URS has superior stone-free rates (79% vs. 68%). The 2007 guidelines offer both SWL and URS as equal first-line options for proximal ureteral stones.The stone-free rate for mid-ureteral stones was not significantly different between URS and SWL, but for distal stones, URS yielded better stone-free rates[53]. The main argument in favor of URS Is that stones could be cleared in one session with minor sequelae in contrast to SWL which has a 20-30% re-treatment rate along with problems associated with passage of fragments[49].

STENTING AND URS

Ureteral stents are usually placed at the completion of ureteroscopy. Ureteral stents Provide drainage and passively dilate the ureter. Pre-stenting prior to URS makes the insertion of ureteroscopes easy. Pre-stenting is also effective in situations where the ureter is narrow and insertion of a Ureteral access sheath or ureteroscope is difficult. In

Left ureteric stent

such instances, placing a stent to passively dilate the ureter and re-attempting URS at a later date is recommended to reduce the rate of complications and improve the rate of ureteral access. Stenting post-ureteroscopy is not always necessary[49]. Denstedt et al[104] , performed the first prospective randomized trial of stent versus no stent following URS . It was observed that at one week after URS, patients without a stent had less dysuria, flank pain and abdominal pain compared to stented patients.

STENTING AND ESWL

Ureteral stents do not improve the stone-free rates in patients treated with SWL and actually impede the passage of stone fragments resulting in lower stone free rates . They should be used prior to treatment with SWL to manage obstruction , intolerable pain ,acute kidney injury, sepsis, and in solitary kidney. If stented for sepsis, a course of antibiotics should be given prior to SWL and the patient should not exhibit signs of sepsis at the time of treatment. Stents do not decrease the risk of steinstrasse or infection following SWL[105]

URETERAL ACCESS SHEATH

Use of a ureteral access sheath (UAS) has been advocated at the time of flexible URS for renal stones for " (1) facilitating flexible URS by allowing easy multiple entry and re-entry to theupper urinary tract and renal collecting system; (2) decrease in intrarenal pressure, which could potentially diminish kidney injury[106] (3) improved irrigation flow thus optimizing vision[107] and(4) the potential to improve stone-free rates by allowing passive egress or active retrieval of fragments". However, the effect of UAS on stone-free rates is not clear, as the evidence is very limited[49].

URETEROLITHOTOMY

In 1882, a calculus was removed from the upper ureter by Bardenheuer ,using an open surgical technique. This is one of the earliest documented cases of open ureterolithotomy. In 1979, laparoscopic ureterolithotomy was introduced by Wickham by a retroperitoneal approach. Subsequently, in 1992, the first transperitoneal laparoscopic ureterolithotomy was performed by Raboy. Ureterolithotomy is the procedure of open or laparoscopic surgical removal of a stone from the ureters. This procedure is surpassed by minimally invasive procedures for fragmentation and removal like ESWL and URS But it still has a role when the above, sophisticated modalities fail or are unavailable particularly in cases involving significant ureteral stricture that preclude endoscopic access. Ureterolithotomy is contraindicated in those patients who are unable to undergo general anesthesia. Generally, mid and upper-ureteric stones are better approached retroperitoneally, while lower ureteric stones are safely approached transperitoneally.

LAPOSCOPIC URETEROLITHOTOMY

Laparoscopic ureterolithotomy is a less invasive intervention for complicated stones that cannot be removed using extracorporeal or ureteroscopic lithotripsy. However, disadvantages of this procedure include the potential for urinary leak, lack of tactile perception, potential for bowel adhesions, and the considerable learning curve. These effects must be considered in surgical planning. During the recent years, minimally invasive surgical ureterolithotomy (MISU), performed by conventional or robotic-assisted laparoscopic/retroperitoneoscopic approach, is increasingly being used for the treatment of large/impacted ureteric stones[108].

TREATMENT SELECTION

Before presenting specific recommendations for ureteral stone management , some general trends underlying the recommendations can be determined. In general , as the size of the stone increases, the intensity of the treatment needs to increase as well, because less intense treatments are less effective with larger stones. As such as stone size increases , SWL becomes less attractive and URS becomes more attractive, with Percutaneous- URS becoming most useful for the very large ureteral stones. Similar trends are apparent with records to location , although the differences are driven more by risk of complications than by efficacy. As location of a ureteral stone becomes more proximal , complications of URS increase , but those of SWL are relatively stable. For a given stone then , the tendency would be to use URS in the distal ureter and SWL for proximal ureter. Other general trends are more obvious; as stones get harder , they are better treated with endoscopy rather than SWL.

MATERIALS AND METHODS

MATERIALS AND METHODS

The study involves a total of 100 patients with calculus disease of theureter seen over a period of 2016 to 2017. All patients were subjected to a detailed clinico epidemiological work up. Complete hemogram, urine analysis, urine culture, serum biochemistry including including urea, creatinine were performed in all patients. Calcium,phosphorus, uric acid, 24 hrs urine study for urinary excretion of calcium, phosphorus and uric acid were performed in selected patients.

INCLUSION CRITERIA

All in-patients aged 12 years or more presented with ureteric calculi

EXCLUSION CRITERIA

1. Ureteric calculi patients treated as out patients.
2. Patients with Calculus involving other than ureter .
3. Incidentally detected ureteric calculi.
4. Ureteric calculi associated with other anomalies like neurogenic bladder, stricture urethra .

STUDY DESIGN

This is an observational study conducted in our institution Thanjavur Medical college Hospital during the period 2016 to 2017.

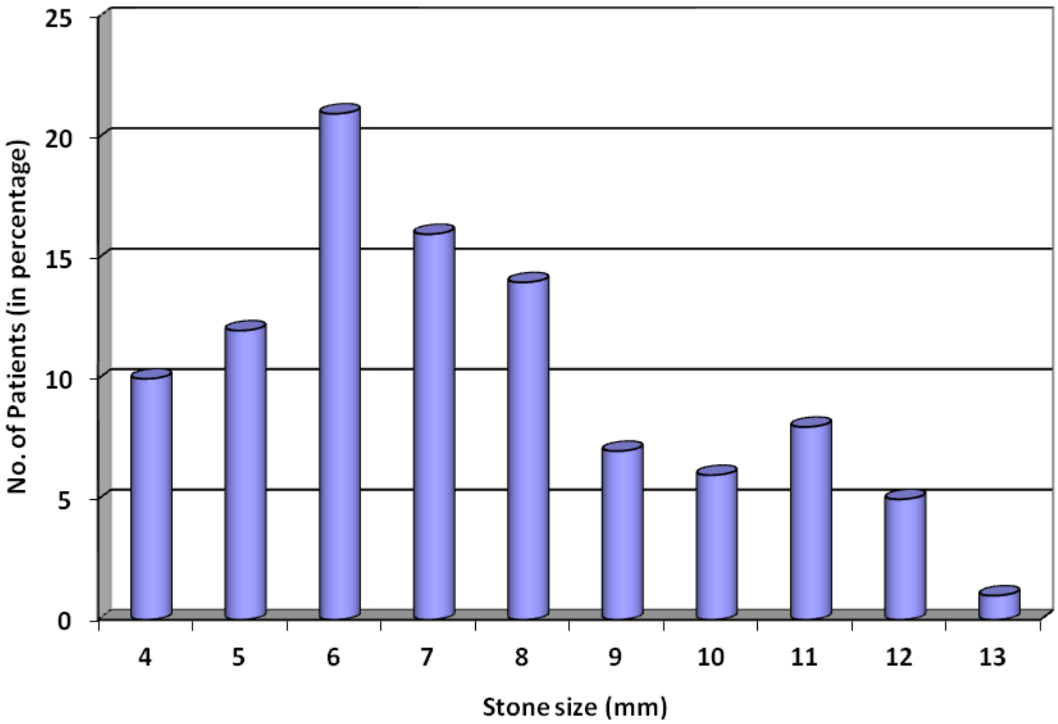
Radiological investigations included plain x-ray, CT abdomen and pelvis, KUB, IVU series, Retrograde urethrogram, Voiding Cystourethrogram and Retrograde ureterogram depending upon the clinical situation. Ultrasonogram was performed in all patients with ureteric calculus and repeated after therapeutic endoscopic procedures.

Cystoscopic stent removal was done who were intervened by ureteroscopy or open surgery.

Patients were asked to come for follow up 1 month and 6 month after therapeutic procedures. Ultrasonogram of KUB was done during follow up period, and treated accordingly.

OBSERVATIONS

FREQUENCY OF PATIENTS WITH THEIR STONE SIZE



OBSERVATIONS

Tables

Table -1

Frequency of patients with their stone size

Serial no	Stone size	Number	Percentage
1	4mm	10	10%
2	5mm	12	12%
3	6mm	21	21%
4	7mm	16	16%
5	8mm	14	14%
6	9mm	7	7%
7	10mm	6	6%
8	11mm	8	8%
9	12mm	5	5%
10	13mm	1	1%
	Total	100	

Most study patients had the ureteric stone size of 6mm to 7mm.

AGE DISTRIBUTION

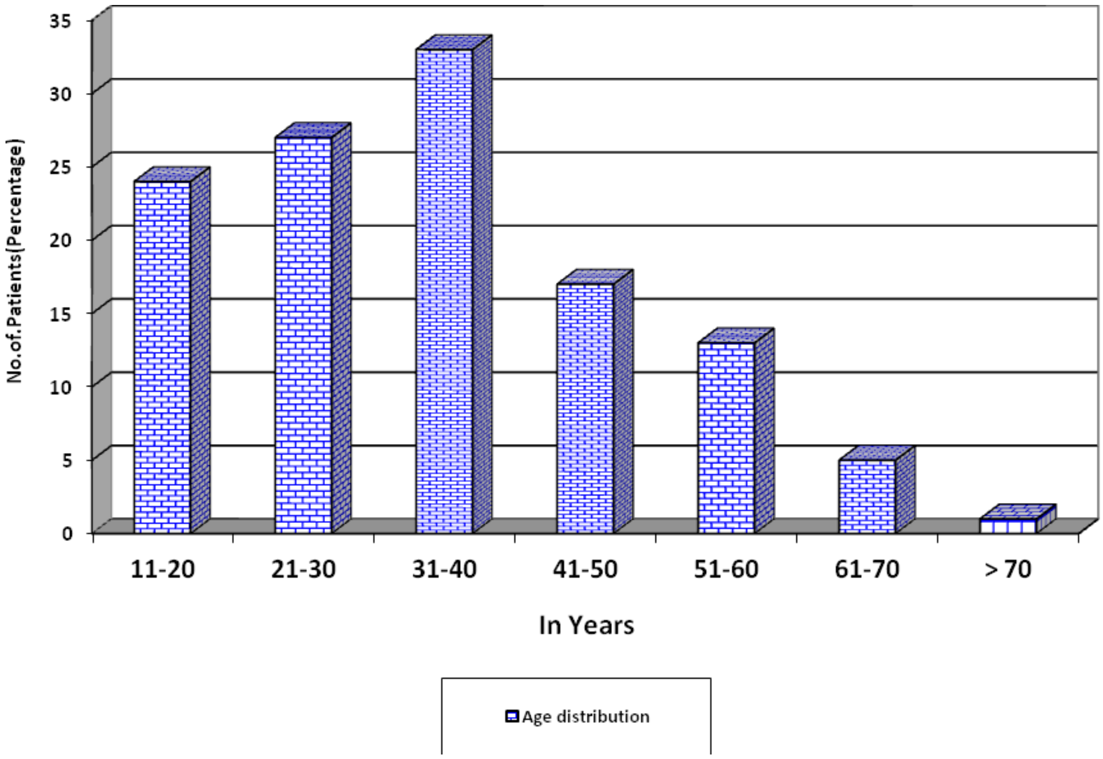


Table -2

Age Distribution

Serial no	Age group	Number of patients	Percentage
1	11-20	24	24%
2	21-30	27	27%
3	31-40	33	33%
4	41-50	17	17%
5	51-60	13	13%
6	61-70	5	5%
7	>70	1	1%

84 % of patients were below 40 years

SITE OF STONE IMPACTION

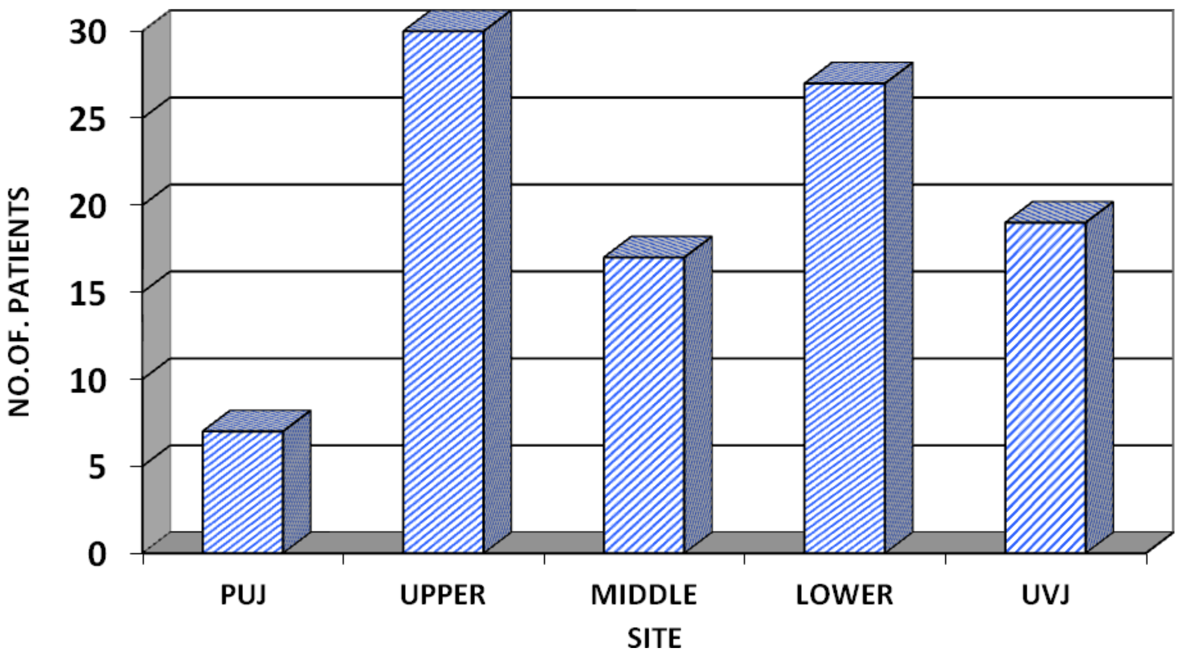


Table -3

Frequency of patients with Site of ureteric stone

Serial number	Site	No. Of patients
1	PUJ	7
2	UPPER	30
3	MIDDLE	17
4	LOWER	27
5	UVJ	19
	TOTAL	100

46% of patients had their stone at lower ureter and UV junction.

37% of patients had their stones in upper ureter.

CLINICAL PRESENTATION

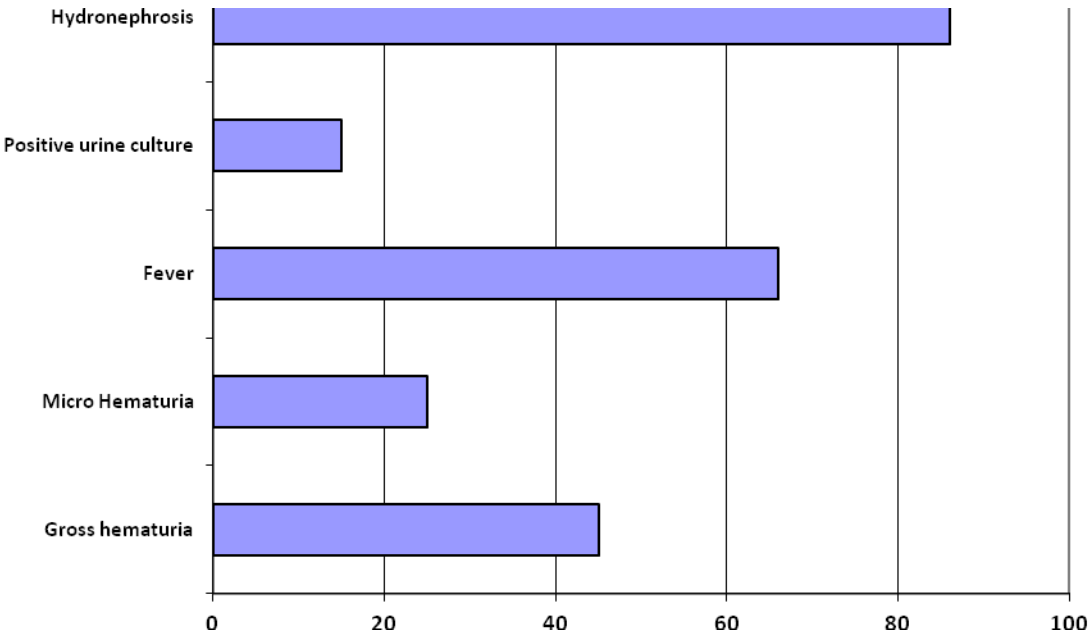


Table 4

Clinical presentation

Observation	No of patients	Percentage
Gross hematuria	45	45%
Micro. Hematuria	25	25%
Fever	66	66%
Positive urine culture	15	15%
Hydronephrosis	86	86%

70% of patients had hematuria.

Most patients had hydronephrosis.

Only 15% of patients had positive urine culture.

MEDICAL MANAGEMENT (BY LOCATION)

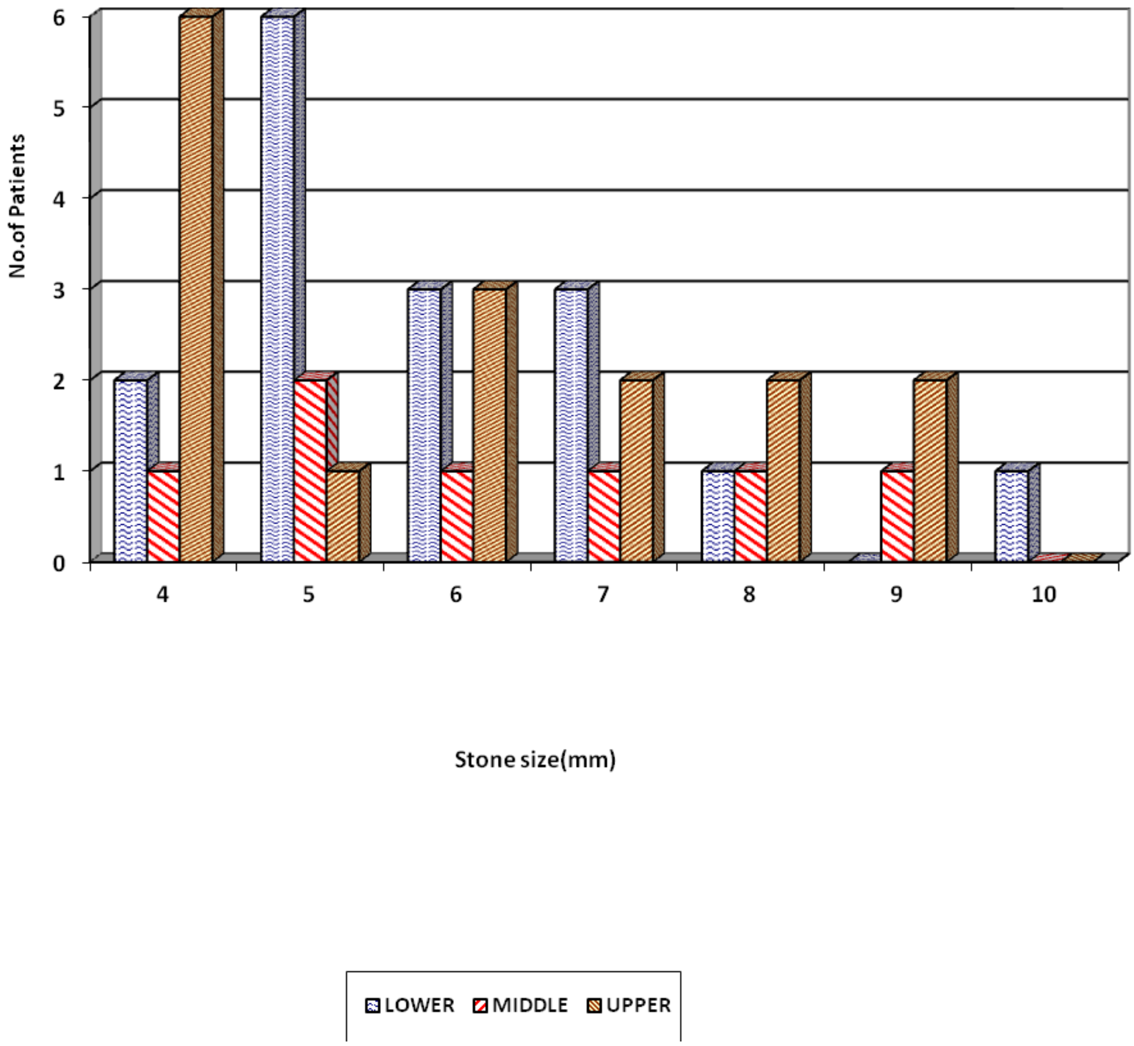


Table -5

Medical management

Location of stone		Stone size(mm)								Total
Lower	Size(mm)	4	5	6	7	8	9	10	11	16
	No.	2	6	3	3	1	0	1	0	
Middle	Size(mm)	4	5	6	7	8	9	10	11	7
	No.	1	2	1	1	1	1	0	0	
Upper	Size(mm)	4	5	6	7	8	9	10	11	16
	no.	6	1	3	2	2	2	0	0	
								Total		39

16 patients with lower ureteric stones were managed medically.

7 patients with middle ureteric stone were managed medically.

16 patients with upper ureteric stones were managed medically.

Maximum size of the stone passed spontaneously was 10mm.

URETEROSCOPIC MANAGEMENT

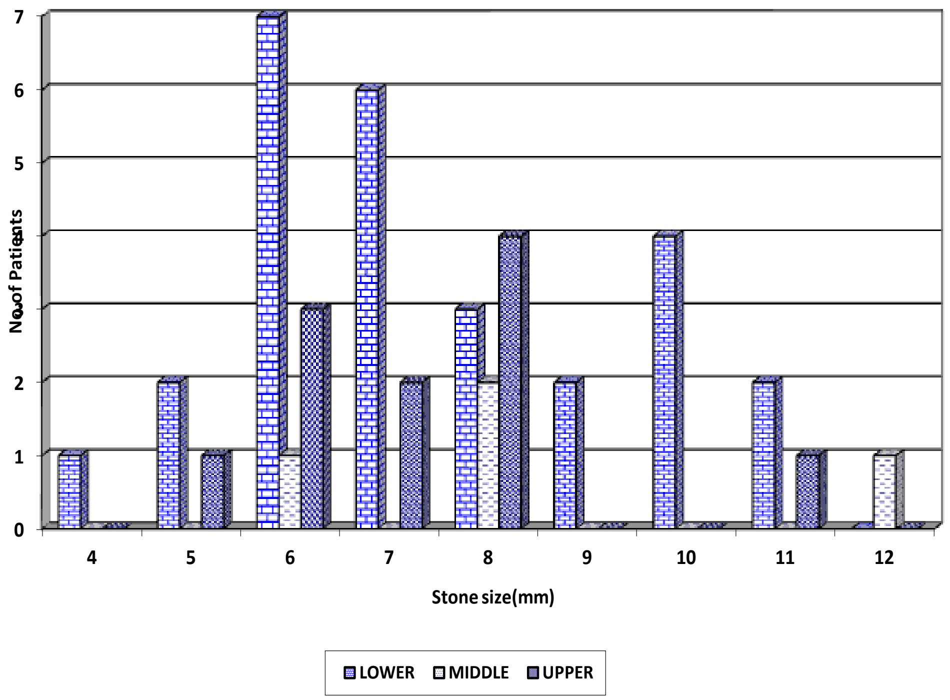


TABLE- 6

Ureteroscopic management

Location of stone		**Stone size (mm)**									**Total**
Lower	Size(mm)	4	5	6	7	8	9	10	11	12	26
	No.	1	2	7	6	3	2	4	2	0	
Middle	Size(mm)	4	5	6	7	8	9	10	11	12	4
	No.	0	0	1	0	2	0	0	0	1	
Upper	Size(mm)	4	5	6	7	8	9	10	11	12	10
	No	0	1	3	2	4	0	0	1		
										Total	40

26 patients with lower ureteric stone were managed endoscopically.

4 patients with middle ureteric stone were managed endoscopically.

11 patients with upper ureteric stone were managed endoscopically.

Maximum size of the stone removed endoscopically was 12mm.

URETERO LITHOTOMY / PYELOLITHOTOMY

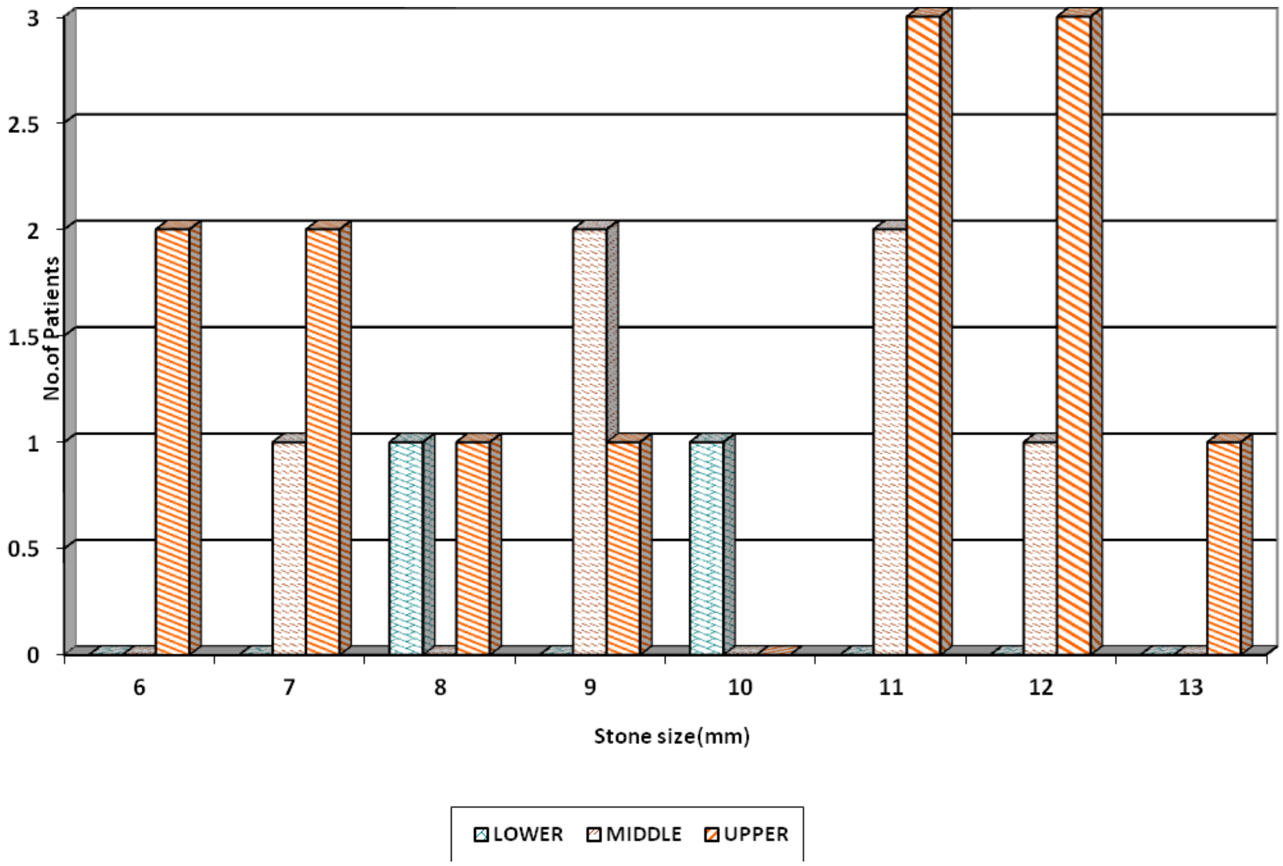


TABLE- 7

Uretero lithotomy/ Pyelolithotomy

Location of stone		Stone size(mm)									Total
Lower	Size(mm)	5	6	7	8	9	10	11	12	13	2
	No.	0	0	0	1	0	1	0	0	0	
Middle	Size(mm)	5	6	7	8	9	10	11	12	13	6
	No.	0	0	1	0	2	0	2	1	0	
Upper	Size(mm)	5	6	7	8	9	10	11	12	13	13
	No.	0	2	2	1	1	0	3	3	1	
										Total	21

2 patients only were undergone ureterolithotomy for lower ureteric calculi.

6 patients were undergone surgery for middle ureteric calculi.

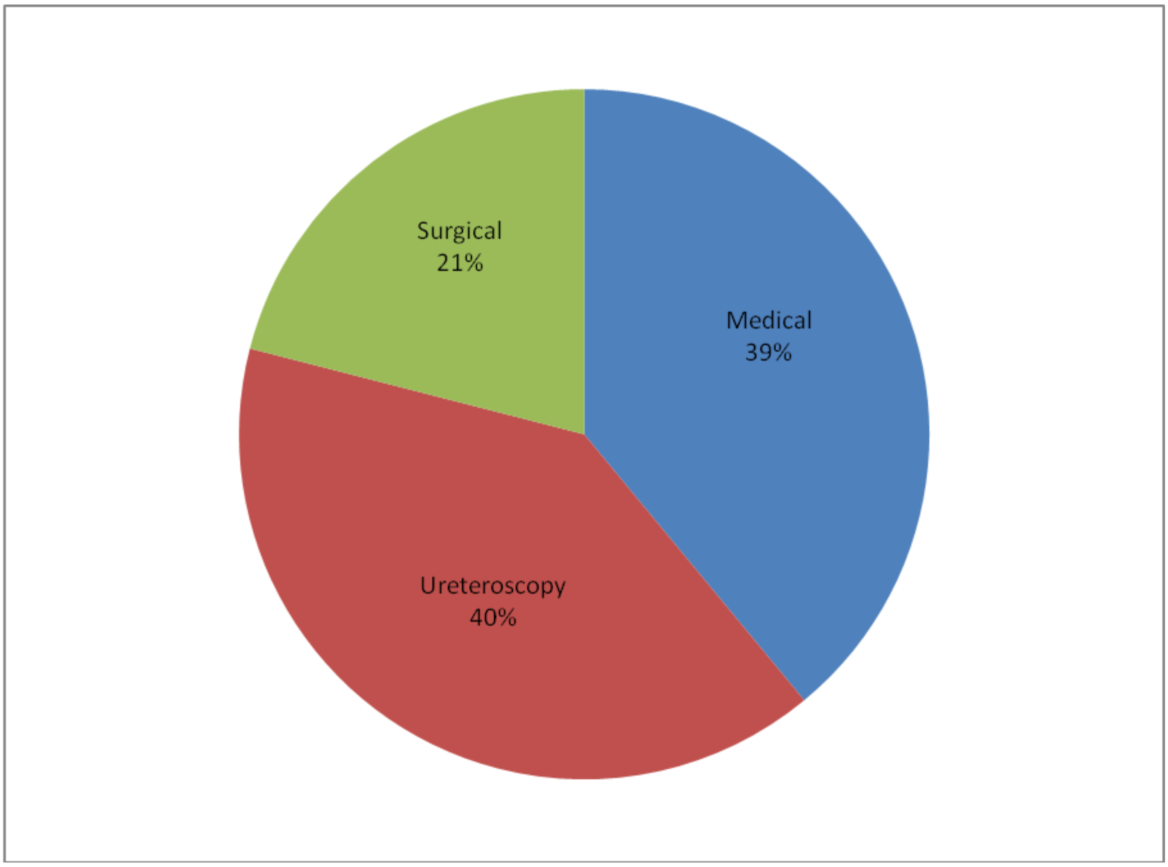
13 patients were undergone surgery for upper ureteric calculi.

Table -8

Positive urine culture micro organisms

Organism	No.	%
E.COLI	8	53
KLEBSIELLA	4	27
PROTEUS	2	13
PSEUDOMONAS	1	7
TOTAL	15	100

Most common organism cultured in patient with ureteric calculi was E.coli which accounts for 53%. E. coli was sensitive to all third generation cephalosporins like cefotaxime.



Pie chart showing line of management

DISCUSSION

DISCUSSION

- A total of 100 patients were included in this study. Of these the maximum incidence of ureteric calculi appeared in the age group of 21 to 49 yrs age group(60%). Several authors have reported 20 to 50 yrs age as the period of maximum incidence of urinary calculi[19,20].However, in the study conducted by Romero and colleagues in countries like Japan and USA, the age at peak incidence was higher ie., around 40-49 years[21].

- Of the 100 patients ,38 patients (38%) were females. The sex incidence ratio is 1.7:1. Scales et al, have observed a similar incidence and have reported sex incidence from 1.7:1 to 1.3:1 male-to-female ratio between 1997 to 2002[28]. Knoll et al, observed a 2.7:1 male-to-female ratio for the most common calcium-containing calculi[29]. In other developing countries, the male-to-female ratio range from 1.6:1 in Thailand and 1.15:1 in Iran [30,31] to 5:1 in Saudi Arabia and 2.5:1 in Iraq[32,33].

- 98% patients presented with colicky abdominal pain , which is the commonest symptom in ureteric calculi.
- 70% of patients were presented with microscopic or macroscopic hematuria.
- 66% of patients had associated fever.

- 37 patients (37%) had calculi in the upper ureter including pelviureteric junction which is explained by its narrowest part of ureter. However,Baker and colleagues[40] have observed a significant predominance of lower ureteral stones with 63% in distal ureter and 87% at the VUJ . Similarly, Song and colleagues[51] ,found that 46.3%, stones were located at ureterovesical junction (UVJ) , 30.5% in proximal ureter and 16.8% of stones in distal ureter.A study from Nepal ,also observed distal ureter to be the most common site of ureteric stone[56] .In the study by Ordon and colleagues[57], stones ≥100 mm were distributed more proximally .
- 54% patients had ureteric stones above pelvic brim.
- Majority of the stones were less than 1 cm in size (86%) while 14% of stones were between 1 to 2 cm . Prstojevic et al[47] showed that the most common size of the calculi observed was 15 mm. This relatively low incidence of larger stones may probably due to patients seeking medical attention immediately once they developed pain. However the mean stone size was 5.7 mm, in the study by Ahmed et al[48]. Song and colleagues[51] observed the mean size of the stones to be 4.87±3.49 mm . The largest stone in our series measured 13 mm.
- There is no specific laterality noted in this study population. Equal distribution between right and left sides of the ureter. Drash[20] and Segura et al[44] have noted a slight preponderance to be the left. Kretschmer[43] , in his review of 500 cases found that 45.8% calculi were right sided and 51.8% were left sided

- 86% of patients were presented with hydronephrosis. Of these , only 5 patients had palpable mass.
- 15 % of individuals had positive urine culture, mainly E.coli as causative organism, which was sensitive to third generation cephalosporins like cefotaxime. Remaining organisms includes Proteus, Klebsiella and Pseudomonas. The findings are similar to the study by Golechha and Solanki[67] wherein E-coli formed the major organism followed by Pseudomonas. However,Holmgren[68] had observed proteus to be the most common organism occurring in 7% of the cases.
- Renal function tests namely blood urea and serum creatinine were done in all patients . 15 patients had marginal elevation in renal parameters. 2 patients had renal failure associated with urosepsis for which emergency surgical intervention were done.
- A plain X –ray of abdomen and pelvis is the simplest test to obtain; however, radiolucent stones, such as uric acid stones and cystine stones, may not be visualized , and stool in the colon may make it difficult to identify smaller stones in the ureter.
- The test of choice at our institution for diagnosing an acute stone is CT abdomen which identifies site, size, and associated hydronephrosis .
- 39 in-patients(39%) were managed medically. Three stones were passed spontaneously after a variable observation of one to seven day . Of them , 18 patients had stone size of 5mm or less. Subsequent scan showed disappearance of stones, hydronephrosis and relief of symptoms. 40% of patients had undergone retrograde ureteroscopy ,of

them 40 patients had successful retrieval of stones. Selection of ureteroscopy depends on the size and location of stones. With the wide usage of ureteroscope, all ureteric stones were tried to remove by endoscopy. 21 patients (21%) were underwent open surgical management in the form of ureterolithotomy and pyelolithotomy. Post operative periods were uneventful.

- Among the medically managed 39 patients , lower ureteric calculi were found in 16 patients. Upper ureteric calculi were found in 16 patients. . Middle ureteric calculi were found in 7 patients.
- 8 out of 11 patients who had the stone size of 5mm or less in lower ureter were passed spontaneously. Spontaneous stone passage rate was 72.4% which is comparable with the reports published by the authors of the 2007 AUA Ureteral Stone Guidelines who showed that 68% of patients with <5mm stone passed spontaneously[53]. Ordon et al[49] have reported that 95% of ureteral stones 2 to 4 mm in size will pass spontaneously.
- 8 out of 33 patients who had the stone size of more than 5mm in lower ureter were passed spontaneously. The maximum size of the stone that passed spontaneously from lower ureter was 10mm. The spontaneous stone passage rate was 24% which is comparable with the results published by the authors of 2007 AUA Ureteral stone guide lines (46%)[53].
- The maximum size of stone that passed spontaneously from upper ureter was 9mm. 16 out of 40 patients who had stones in the upper ureter were passed spontaneously, with a passage rate of 40%. Coll

and colleagues[52] , have observed a spontaneous passage rate based on stone location which was 48% for those in the proximal ureter, 60% for mid ureteral stones, 75% for distal ureteral stones, and 79% for stones in the ureterovesical junction.

- 7 out of 14 patients who had stones in the middle ureter were passed spontaneously. The maximum size of stone that passed is 9mm.
- Among the 41 patients who underwent ureteroscopic stone removal , 26 patients were from lower ureteric region, 4 patients from middle ureteric region, 11 patients from upper ureteric region.
- The maximum size of the stone that was removed by ureteroscopy was 12mm in size.
- 50% (13 out of 26) of stones removed from lower ureter was 6mm or 7mm in size . Ureteroscopic removal of stone for lower ureteric calculi is preferred line of treatment than open surgical procedures .
- Among the 21 patients who underwent ureterolithotomy or pyelolithotomy , 13 patients [62%] had their stones in the upper ureter. Upper ureteric stones were removed commonly by open surgery when its size was more than 10mm.
- The maximum size of the stone that was removed by open surgey was 13mm in our study.

All patients were stayed for an average period of 7 to 10 days as compared to 3 to 5 days after endoscopic stone removal.

Few patients were discharged the next day of endoscopy. No one reported pain after endoscopy. Morbidity related to endoscopic procedure was minimal hence this should be the first line of management even in patients with upper ureteric calculi.

Only one patient with upper ureteric calculus of size 8mm was not removed by ureteroscopy , which was removed by open surgery. All patients who underwent open surgery were followed in post operative period for 1 month , and after a 6 month period. They underwent follow up Ultrasonogram of KUB. Only 2 patients had non obstructive renal calculi which was managed conservatively. Ureteric stents were removed by cystoscopy

CONCLUSIONS

CONCLUSIONS

1. The peak age incidence of ureteric calculi was found in the age group of 21-49 yrs and the male to female ratio was 1.7:1
2. There was no specific laterality noted in this study. Right and left side of ureter had equal number of distribution.
3. 54% of patients had ureteric stones above pelvic brim.
4. 86% of stones were less than 1 cm I size.
5. 15% of patients had positive urine culture mainly E.coli as causative organism.
6. Colicky abdominal pain, hematuria and fever were the main presenting problems.
7. Most patients with ureteric calculi had normal renal function tests.
8. USG was the main investigation for diagnosing ureteric calculi.
9. Lower ureteric stone of size 5mm or less passed spontaneously with stone passage rate of 72.4%. It is concluded that symptomatic management with observation is preferred in lower ureteric calculi with stone size of 5mm or less.
10. Ureteroscopic stone removal is the preferred line of management in patients with lower ureteric calculi of size more than 5mm.
11. Ureterolithotomy or pyelolithotomy was the line of management in patients with large stone size (greater than 1 cm) , difficult location and correction of associated problems.

SUMMARY

The past several decades have seen profound advancements in the management of upper urinary tract urolithiasis. SWL, URS, and PCNL have rendered open stone surgery virtually obsolete. Although factors such as obesity , stone fragility, and unfavorable stone location present challenges to the urologist , new instruments such as smaller caliber ureteroscopes and laser fibers allow increasing numbers of stones to managed with high success rates and minimal patient morbidity. It is imperative for surgeons to keep appraised of new technology and techniques to provide individualized treatments for each patient with greatest chance of success.

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PROFORMA

STUDY OF URETERIC CALCULI

NAME: AGE: SEX: OCCUPATION:

IPNO: DOA: DOD:

COLICKY PAIN/ HEMATURIA / FEVER

PAST HISTORY:

PREVIOUS H/O URETERIC COLIC /FAMILY H/O STONE DISEASE

EXAMINATION:

PULSE: BP: TEMP:

CVS
RS:

ABDOMEN: TENDERNESS
RENAL ANGLE TENDERNESS
MASS
INVESTIGATIONS:

RBS	BL.UREA	SR.CREATININE	URINE ROUTINE	URINE MICROSCOPY

PLAIN X -RAY KUB

USG ABDOMEN

INTRA VENOUS UROGRAPHY

CT ABDOMEN

STONE:

SIZE

LATERALITY: RIGHT/ LEFT

SITE : UPPER/MIDDLE/ LOWER/ UVJ/ PUJ

TREATMENT

MEDICAL

SURGICAL-

URETEROSCOPIC REMOVAL

OPEN SURGERY

URETEROLITHOTOMY

PYELOLITHOTOMY

FOLLOW UP

OUTCOME

MASTER CHART

S.NO	NAME	AGE/SEX	PAIN	HEMATURIA	FEVER	TENDERNESS	SITE	SIZE	HYDRONEPHROSIS	MEDICAL	URS	ULT	OUTCOME
1	RAMESH	40/M	YES	MICROSCOPIC	NO	YES	R-LOWER	4mm	NO	YES			IMPROVED
2	KUMAR	35/M	YES	MICROSCOPIC	NO	YES	R-MIDDLE	9mm	YES			YES	CURED
3	RANJITH	26/M	YES	NO	NO	YES	R-UVJ	5mm	YES	YES			IMPROVED
4	RANI	35/F	YES	MICROSCOPIC	YES	YES	R-LOWER	6mm	YES		YES		CURED
5	MUTHU	43/M	YES	NO	YES	YES	R-LOWER	7mm	YES		YES		CURED
6	BALAKRISHNAN	17/M	YES	NO	YES	YES	R-UPPER	6mm	YES			pyelolithot	CURED
7	RAHEEM	32/M	YES	NO	NO	YES	R-LOWER	4mm	YES		YES		CURED
8	ANJUTHAM	45/F	YES	MICROSCOPIC	NO	NO	R-MIDDLE	7mm	YES			YES	CURED
9	ARIVALAGN	32/M	YES	NO	YES	YES	L-MIDDLE	6mm	YES		YES		CURED
10	RAVI	33/M	YES	MICROSCOPIC	NO	NO	L-LOWER	7mm	YES		YES		CURED
11	MUTHULAKSHMI	23/F	YES	NO	YES	YES	L-LOWER	4mm	NO	YES			IMPROVED
12	GOPIKUMAR	65/M	YES	MICROSCOPIC	YES	NO	L-UPPER	4mm	NO	YES			IMPROVED
13	MARIYAYI	70/F	YES	NO	NO	YES	L-UVJ	5mm	NO	YES			IMPROVED
14	MANI	23/M	YES	MICROSCOPIC	NO	YES	R-LOWER	6mm	YES		YES		CURED
15	SAMY	65/M	YES	NO	YES	NO	R-UVJ	5mm	YES		YES		CURED
16	AMULMARY	37/F	YES	NO	NO	YES	R-UPPER	4mm	NO	YES			IMPROVED
17	SIVASUBRAMANI	40/M	YES	YES	YES	YES	L-UPPER	4mm	NO	YES			IMPROVED
18	MARIYAM	60/F	YES	YES	NO	YES	L-MIDDLE	5mm	YES	YES			IMPROVED
19	RAJENDRAN	19/M	YES	NO	NO	YES	R-PUJ	4mm	YES	YES			IMPROVED
20	VENKATESWARI	35/F	YES	MICROSCOPIC	NO	YES	L-LOWER	5mm	NO	YES			IMPROVED
21	SELVAMANI	30/F	YES	NO	NO	YES	L-UPPER	6mm	YES		YES		CURED
22	RAJASEKAR	40/M	YES	YES	NO	YES	L-LOWER	7mm	YES		YES		CURED
23	PANDIYAN	26/M	YES	MICROSCOPIC	YES	YES	R-LOWER	5mm	YES		YES		CURED
24	RANGARAJAN	35/M	YES	NO	YES	YES	R-UPPER	6mm	YES		YES		CURED
25	PANDIAMMAL	50/F	YES	NO	NO	YES	R-LOWER	7mm	YES		YES		CURED
26	MUTHU	60/M	YES	YES	YES	YES	L-UVJ	6mm	YES		YES		CURED
27	NALLATHAMBI	25/M	YES	NO	NO	NO	L-UPPER	8mm	YES		YES		CURED
28	RAJESWARI	27/F	YES	NO	NO	YES	R-UPPER	7mm	YES		ATTEMPTED	ULT	CURED
29	RAJAMANI	49/F	YES	YES	NO	YES	L-UVJ	6mm	YES		YES		CURED
30	SOUNDARAJAN	53/M	NO	YES	YES	NO	L-UVJ	7mm	YES		YES		CURED
31	ARJUN RAM	34/M	YES	NO	NO	YES	L-UPPER	7mm	YES		YES		CURED
32	RANGARAJAN	54/M	YES	YES	YES	YES	L-LOWER	6mm	YES		YES		CURED
33	RAJKUMAR	25/M	YES	NO	YES	YES	R-MIDDLE	8mm	YES		YES		CURED
34	SARAN	74/M	YES	MICROSCOPIC	NO	YES	L-UPPER	7mm	YES			YES	CURED
35	RAJAN	55/M	NO	NO	YES	NO	L-PUJ	6mm	YES			YES	CURED
36	BARANI	24/M	YES	MICROSCOPIC	YES	YES	R-UVJ	6mm	YES		YES		CURED
37	LOGANATHAN	57/M	YES	NO	YES	YES	L-MIDDLE	9mm	YES			YES	CURED
38	MUNIYAMMAL	28/F	YES	NO	YES	YES	R-MIDDLE	8mm	YES		YES		CURED
39	SINGARAM	55/F	YES	YES	NO	YES	R-UPPER	5mm	YES		YES		CURED
40	INDIRA	58/F	YES	MICROSCOPIC	YES	YES	R-UPPER	8mm	YES			pyelolithot	CURED
41	RAVI	35/M	YES	NO	YES	YES	R-LOWER	7mm	YES		YES		CURED
42	KARTHIKEYAN	48/M	YES	YES	YES	YES	R-UVJ	8mm	YES		YES		CURED
43	MUMTAJ	46/F	YES	YES	YES	YES	L-LOWER	6mm	YES		YES		CURED
44	PAPPAMMAL	38/F	YES	YES	YES	YES	L-PUJ	7mm	YES	YES			IMPROVED
45	RAJKUMAR	36/M	YES	MICROSCOPIC	NO	YES	L-UPPER	9mm	YES			pyelolithot	CURED
46	MUTHAMMAL	32/F	YES	NO	YES	YES	R-LOWER	5mm	NO	YES			IMPROVED
47	BALAJI	60/M	YES	NO	NO	NO	L-UPPER	4mm	NO	YES			IMPROVED
48	PADMINI	51/F	YES	YES	YES	NO	L-MIDDLE	4mm	YES	YES			IMPROVED
49	SOLAIAMMAL	48/F	YES	YES	NO	NO	L-UVJ	6mm	YES	YES			IMPROVED
50	GANESAN	26/M	YES	NO	NO	YES	R-LOWER	6mm	YES	YES			IMPROVED
51	PALANIVEL	30/M	YES	MICROSCOPIC	YES	NO	R-MIDDLE	5mm	YES	YES			IMPROVED
52	PALANIYAMMAL	27/F	YES	NO	YES	YES	R-UPPER	7mm	YES	YES			IMPROVED
53	KATHAN	49/M	YES	YES	YES	YES	R-LOWER	5mm	NO	YES			IMPROVED
54	RAJESWARI	31/F	YES	NO	NO	NO	R-UPPER	4mm	NO	YES			IMPROVED
55	SIVA	40/M	YES	YES	YES	NO	R-	8mm	YES			YES	CURED

							LOWER						
56	MURUGESAN	29/M	YES	NO	YES	NO	L-MIDDLE	8mm	YES	YES			IMPROVED
57	SUNDARAM	13/M	YES	YES	YES	NO	L-LOWER	5mm	YES	YES			IMPROVED
58	KANAKAVALLI	46/F	YES	YES	YES	YES	R-LOWER	8mm	YES	YES			IMPROVED
59	MURUGAIYAN	34/M	YES	NO	YES	YES	L-MIDDLE	6mm	YES	YES			IMPROVED
60	BASKAR RAJA	35/M	YES	MICROSCOPIC	NO	NO	R-UPPER	5mm	NO	YES			IMPROVED
61	ARUN KUMAR	40/M	YES	YES	NO	YES	L-UPPER	9mm	YES	YES			IMPROVED
62	SRIDEVI	27/F	YES	MICROSCOPIC	YES	YES	R-MIDDLE	12mm	YES		YES		CURED
63	KALIAMMAL	28/F	YES	MICROSCOPIC	YES	YES	R-UPPER	8mm	YES		YES		CURED
64	VINOTH	45/M	YES	NO	YES	YES	R-LOWER	10mm	YES		YES		CURED
65	PANNERSELVAM	28/M	YES	YES	YES	YES	R-UPPER	11mm	YES			YES	CURED
66	SURESH	30/M	YES	YES	YES	YES	L-LOWER	9mm	YES		YES		CURED
67	KATHAIYAN	24/M	YES	YES	YES	YES	R-UPPER	6mm	YES	YES			IMPROVED
68	VENNILA	45/F	YES	YES	YES	YES	L-LOWER	7mm	NO	YES			IMPROVED
69	SENTHILKUMAR	32/M	YES	NO	YES	YES	L-UPPER	8mm	YES	YES			IMPROVED
70	ARPUTHAMMAL	40/F	YES	YES	YES	NO	R-LOWER	11mm	YES		YES		CURED
71	KALA	25/F	YES	MICROSCOPIC	YES	NO	R-MIDDLE	7mm	YES	YES			IMPROVED
72	CHANDRAKESAN	51/M	YES	YES	NO	NO	R-UPPER	8mm	YES		YES		CURED
73	DURAI	22/M	YES	YES	YES	YES	R-UPPER	12mm	YES			YES	CURED
74	ABIRAMI	60/F	YES	MICROSCOPIC	YES	NO	L-UVJ	10mm	YES		YES		CURED
75	NATESAN	43/M	YES	YES	YES	YES	L-PUJ	11mm	YES			pyelolithot	CURED
76	VARATHARAJ	5O/M	YES	YES	YES	YES	L-UVJ	10mm	YES			pyelolithot	CURED
77	SELLAPPAN	40/M	YES	YES	YES	YES	R-PUJ	12mm	YES			pyelolithot	CURED
78	BALU	38/M	YES	YES	NO	NO	R-PUJ	11mm	YES			pyelolithot	CURED
79	SELVARANI	25/F	YES	YES	YES	YES	L-UPPER	13mm	YES			pyelolithot	CURED
80	PALANISAMY	47/M	YES	YES	NO	YES	L-UVJ	8mm	YES		YES		CURED
81	AROKIYASAMY	70/M	YES	YES	YES	YES	L-UVJ	10mm	YES	YES			IMPROVED
82	LOGAMBAL	38/F	YES	YES	YES	YES	L-MIDDLE	11mm	YES			ULT	CURED
83	SRINIVASAN	39/M	YES	YES	YES	YES	R-UPPER	12mm	YES			ULT	CURED
84	BAMA	36/F	YES	MICROSCOPIC	YES	NO	L-UVJ	10mm	YES		YES		CURED
85	LAKSHMI	40/F	YES	YES	YES	YES	L-UVJ	9mm	YES		YES		CURED
86	SEBASTIN	26/M	YES	MICROSCOPIC	YES	YES	L-UPPER	8mm	YES	YES			IMPROVED
87	VIJAYRAJ	30/M	YES	YES	NO	NO	R-MIDDLE	12mm	YES			ULT	CURED
88	RAMARAJ	40/M	YES	YES	YES	YES	L-LOWER	7mm	YES	YES			IMPROVED
89	KANNADASAN	70/M	YES	YES	YES	YES	L-UPPER	6mm	YES	YES			IMPROVED
90	KUMARAVEL	27/M	YES	YES	NO	NO	R-UVJ	8mm	YES		YES		CURED
91	SANGEETHA	58/F	YES	MICROSCOPIC	YES	YES	L-UPPER	9mm	YES	YES			IMPROVED
92	SENTHIL	29/M	YES	YES	YES	YES	L-LOWER	6mm	YES	YES			IMPROVED
93	KAMALAM	40/F	YES	MICROSCOPIC	YES	YES	L-PUJ	7mm	YES	YES			IMPROVED
94	DINESHKUMAR	16/M	YES	YES	YES	YES	R-MIDDLE	9mm	YES	YES			IMPROVED
95	AYYANAR	47/M	YES	YES	YES	YES	L-UVJ	10mm	YES		YES		CURED
96	SURENDRAN	25/M	YES	YES	YES	YES	R-UVJ	11mm	YES		YES		CURED
97	MEGALAI	34/F	YES	MICROSCOPIC	YES	YES	L-UVJ	9mm	YES		YES		CURED
98	POONGODI	40/F	YES	YES	YES	YES	R-MIDDLE	11mm	YES			ULT	CURED
99	BAGYAM	46/F	YES	YES	YES	YES	R-UPPER	11mm	YES		YES		CURED
100	KUMARAGURU	46/M	YES	MICROSCOPIC	NO	NO	L-UPPER	6mm	NO	YES			IMPROVED